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# EXPOSURE OF ATMOSPHERIC EXPLORER SATELLITES TO VAN ALLEN BELT RADIATION

## MISSIONS C, D, AND E

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GSFC

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

# EXPOSURE OF ATMOSPHERIC EXPLORER SATELLITES

# TO VAN ALLEN BELT RADIATION

Missions C, D, and E

A special study to determine the particle flux densities anticipated for the AE missions as a function of nominal orbit parameters

by

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MISSIONS C, D, AND E

Foreword:

At the request of the AE Project Office a study was conducted to determine the particle flux densities anticipated for the AE missions as a function of nominal orbit parameters.

This data was needed in order to select electronic circuit designs that would be able to perform satisfactorily in the predicted radiation environment.

In this context it should be noted that the results represent isotropic intensities, supposedly for all values of the integral proton and electron spectra.

The information contained in the present report supersedes all older data, especially the data released earlier this year in connection with and prior to the "Extreme Ultraviolet Photometer Experiment" contract award for Dr. D. Heath.

INTRODUCTION:

High inclination circular and elliptical trajectories ($i > 55°$) or low inclination elliptical orbits of large eccentricity traverse the terrestrial radiation belts twice during each revolution. The vehicle thus executes a transverse motion in L-space, passing successively through a region of low L-values ($1.0 \lesssim L \lesssim 2.0$) and of high L-values ($2.0 \lesssim L \lesssim 6.6$), commonly referred to as the inner zone and the outer zone. The AE-C,D,E trajectories (for details see Appendix A) perform in a very similar way.

The three specified AE missions lie all within a two-year interval of time approximately coinciding with the next solar minimum. This means that conditions prevailing then in the radiation belts will most likely be similar to those that prevailed during the last solar minimum, namely 1964, with the exception of the artificial electrons that populated the inner zone from 1962/7 to about 1968. Since the electron fluxes are calculated with Vette's AE2 model, which describes the environment as it existed back in 1964, it is reasonable to assume that the outer zone predictions given in this report will be a good approximation for 1974. Of course, to obtain valid 1974 predictions for the inner zone, the artificial component had to be removed; this was done by decaying the fluxes exponentially up to 1967/6, when it is felt, that natural background levels were reached. Orbital flux integrations for high energy protons

were performed with Vette's current models AP1, AP6, AP7. Low energy protons were calculated with King's AP5 model. All are static models, including the AE2, which do not consider temporal variations. For the protons this is a valid representation because experimental measurements have shown that no significant changes with time have occurred. With the exception of the fringe areas of the proton belt, that is, at very low altitudes and at the outer edges of the trapping region, the possible error introduced by the static approximation lies well within the uncertainty factor of 2, attached to the models. Consequently, the proton models may be applied to any epoch without the need for an updating process.

Appendix A contains other pertinent background information with regard to units, field models, trajectory generation and conversion, etc. At this point, we wish to emphasize again that our calculations are only approximations; we strongly recommend that all pers ns to receive parts of this report be advised about the uncertainty in our data.

The results were obtained for the basic elliptical orbit of the AE mission at the individual inclinations specified for each mission. By placing the initial injection point, that is, the location of the first perigee position, arbitrarily at (0,0) longitude and latitude, we may have biased the flux predictions. It is conceivable that a rotation of the first perigee in the plane of the orbit and a relocation, let us say diametrically opposite, may produce substantially different results. So far, we have not had an opportunity to test this hypothesis.

## RESULTS: ANALYSIS AND DISCUSSION

Our calculations for the AE-C,D,E are summarized in Tables 1 to 9, separately for protons and for electrons. A graphical superposition of the spectral distribution is given in Figure 1 for electrons and Figure 2 and 2A for protons, and a selected set of integral energies are plotted versus inclination in Figure 3, for both types of particles. Classification of orbit - integrated spectra as hard or soft is relative, based on an overall evaluation of near earth space in terms of circular trajectories between equatorial and polar orbits.

On some preliminary graphs discontinuities appeared in the high energy proton spectra. These "breaks" occurred because the complete proton environment is being described by three (formerly four) independent maps or grids, each valid only over a limited energy range; for certain critical orbital configurations the discontinuities are then produced when moving from one energy range to another. They are caused, in part, by the exponential energy parameter of the model which in many instances had to be exerapolated to make up for lacking data and, in part, to insufficient experimental measurements over some areas of B/L-space; furthermore, the discontinuities reflect the fact that the available data cannot be completely matched at their overlap. In order to overcome such spectral breaks, a continuous weighted mean curve was drawn, connecting

the adjacent segments; it should be regarded as an approximate spectral distribrtion. In doing this, the AP1 results ($30 < E(Mev) < 50$) had to be totally ignored sometimes.

A similar break occurs in the low energy spectrum, at the interface between the AP5 and the AP6 models. It appears that for the specific orbits under consideration, the AP5 underestimates the predicted vehicle encountered fluxes, maybe by as much as a factor of 4. This, however, may be partially due to the elliptical form of the orbit.

Figures 1 and 2 indicate a slight hardening of the spectra for lower inclinations in addition to an increase in the average daily fluxes. The electron spectra may be classified as moderately hard for near earth space missions, while the protons rate a "hard" classification for energies $E > 3$ Mev but a "very hard" one when a threshold energy of $E > 50$ Mev is considered. Figure 3 bears out these findings. Figures 4 to 9 are computer plots depicting the characteristic electron and proton spectra of the three trajectories, individually.

In Figure 10 the percentage of total lifetime T spent by the vehicle in the inner zone ($T^i$) and in the outer zone ($T^o$) is given, with the percent duration spent outside the trapped particle radiation belt ($L > 6.6$), denoted by $T^e$ (T-external).

For any mission (j) then:

$$T_j = T_j^i + T_j^o + T_j^e = 100\%$$

Evidently, the low inclination AE-E spends its entire lifetime in the inner zone. When inclination is raised to $i = 65^o$ for the AE-C, the vehicle spends the largest proportion of its lifetime in the outer zone while it briefly visits regions of space outside the Van Allen belts. In this stage the satellite performs a complete sweep through magnetic L-space, which constitutes the transverse motion mentioned in the second paragraph, executed twice during each revolution (orbit). Finally, the AE-D at $i = 80^o$ would spend about 16% of its entire lifetime outside the radiation belts while remaining for shorter periods of time in the inner and outer zones than the AE-C.

The following related points are submitted for consideration in connection with the lifetime distribution over distinct regions of space:

a. Lasting solar cycle effects are more severely experienced in the <u>outer zone</u> (significant changes in the trapped electron population from solar minimum to solar maximum).

b. Energetic artificial electrons from high altitude nuclear explosions (Starfish) have displayed a remarkable longevity, <u>but only in the inner zone</u>; there they contaminated the environment for over 5 years, while they rapidly decayed to background levels in the outer zone (within weeks to months). A planned or

accidental explosion of another atomic device with the appropriate yield and at the right latitude and altitude may, very likely, produce conditions similar to those experienced with "Starfish", transforming the inner zone again into a radiation hotbed.

c. Transient solar flare effects (high energy solar proton fluxes), may be especially hazardous and damaging in regions external to the trapped particle belts.

In Figure 11 the percentage of total lifetime spent in flux-free regions of space $T^{ff}$ is given, where the term "flux-free" applies to all regions of space where trapped-particle intensities are less than one electron or proton per square centimeter per second, having energies $E > .5$ Mev and $E > 5$ Mev, respectively. This, of course, includes regions outside the Van Allen belts. Predictably, the high energy proton population, which occupies a smaller volume of the radiation belt, affords a much larger $T^{ff}$ than the electrons. As inclination rises the flux-free time increases for both types of particles, but at a much higher rate for the protons, because of the smaller volume occupied by these particles.

If $T^{ff}$ is included as a decisive mission criterion into planning, a prior evaluation and comparison of the radiation hazards due

to the predicted electron and proton fluxes is essential, either in regard to the entire mission or in regard to specific important functions or requirements. For, while the proton intensities are on the average two orders of magnitude smaller than the electrons, and while they apparently do afford more flux-free time between $i = 20°$ and $i = 81°$, their greater mass and harder spectra may prove more damaging to the mission than the more numerous electrons with their less flux-free time.

Figures 12 to 17 are additional computer plots for the three AE trajectories showing the vehicle encountered instantaneous peak electron (E .5 Mev) and proton (E 5 Mev) intensities per orbit for a sequence of about 22 revolutions. On all graphs a periodic pattern emerges that indicates a daily cycle of about 11 orbits which may shift slightly in the plotting. This is due to the relative orbit period, which determines the precession of the trajectory. The pattern may change with time as the dynamics of the elliptical orbit and the external perturbations alter the flight path.

It is evident that inclination affects the peaks very little for both types of particles. There is relatively no significant variation in the peak-levels over a daily cycle, contrary to circular orbits, which experience flux-less intervals of time, occasionally lasting several revolutions.

Finally, for each of the three flight paths, two more computer plots are included, Figures 18 to 23, one for protons and one for electrons, depicting the characteristic averaged instantaneous intensities of the trajectory in terms of constant L-bands of .1 earth radius width; the percent of total lifetime spent in each L-interval is shown on the same graph by the contour marked with x's.

## APPENDIX A

### General Background Information

For the specified trajectories, orbit tapes were generated with an integration stepsize of one minute and for sufficiently long flighttime, so as to insure an adequate sampling of the ambient environment; on account of their period, which determine the rate of orbit-precession, the following elliptical flight paths of 48-hour duration were produced:

| Inclination | Perigee | Apogee | Mission |
|---|---|---|---|
| 23° | 150 km | 4000 km | AE-E |
| 65° | " | " | AE-C |
| 80° | " | " | AE-D |

The orbits were subsequently converted from geocentric polar into magnetic B-L coordinates with McIlwain's INVAR program of 1965 and the field routine ALLMAG by Stassinopoulos and Mead, utilizing the POGO (10/68) geomagnetic field model by Cain and Langel, calculated for the epoch 1974.0 (B is the field strength at a given point and L is the geocentric distance to the intersect of the field line, through that point, with the geomagnetic equator).

Orbital flux integrations were performed with Vette's current models of the environment, the AE2 for electrons and the AP1, AP6, AP7 for high energy protons, and the AP5 for low energy protons. All are static models which do not

consider temporal variations. See the text of the report for further details on this matter.

The results, relating to omnidirectional, vehicle encountered, integral, trapped particle fluxes, are presented in graphical and tabular form with the following unit convention:

1. Daily averages : total trajectory integrated flux averaged into particles/$cm^2$day;
2. Totals per orbit : non-averaged, single-orbit integrated flux in particles/$cm^2$orbit;
3. Peaks per orbit : highest orbit-encountered instantaneous flux in particles/$cm^2$sec;

where 1 orbit = 1 revolution.

Please note: We wish to emphasize the fact that the data presented in this report are only approximations. We do not believe the results to be any better than a factor of 2 for the protons and a factor of 3 for the electrons. It is advisable to inform all potential users about this uncertainty in the data.

TABLE 1

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * GRIDS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971, DAY 0138
INCLINAT.= 23 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TD 6160 * PERIOD = 2.148 * VEHICLE = AE-E

HIGH ENERGY

SPECTRUM IN % DE

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 3-5 | 7.029E 10 | 68.038 |
| 5-15 | 2.999E 10 | 29.026 |
| 15-30 | 2.314E 09 | 2.240 |
| 30-50 | 3.567E 08 | 0.345 |
| 50-100 | 1.494E 08 | 0.145 |
| >100 | 2.131E 08 | 0.206 |
| TOTAL = | 1.033E 11 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR. THAN (MEV) | AVERAGED INTEG. FLUX (PER DAY) |
|---|---|
| 1 | NOT VALID |
| 3 | 1.033E 11 |
| 5 | 3.302E 10 |
| 7 | 1.572E 10 |
| 9 | 9.086E 09 |
| 11 | 5.888E 09 |
| 13 | 4.114E 09 |
| 15 | 3.034E 09 |
| 18 | 2.065E 09 |
| 21 | 1.496E 09 |
| 24 | 1.135E 09 |
| 27 | 8.911E 08 |
| 30 | 7.192E 08 |
| 35 | 5.577E 08 |
| 40 | 3.624E 08 |
| 45 | 2.383E 08 |
| 50 | 3.625E 08 |
| 60 | 3.259E 08 |
| 70 | 2.930E 08 |
| 80 | 2.634E 08 |
| 90 | 2.369E 08 |
| 100 | 2.131E 08 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>5) |
|---|---|---|
| 0.E0-1.E0 | 11.050 | 2.954E 04 |
| 1.E0-1.E1 | 0.683 | 1.048E 04 |
| 1.E1-1.E2 | 0.817 | 1.175E 05 |
| 1.E2-1.E3 | 1.233 | 1.836E 06 |
| 1.E3-1.E4 | 2.750 | 4.384E 07 |
| 1.E4-1.E5 | 7.633 | 1.332E 09 |
| 1.E5-OVER | 23.850 | 6.467E 10 |
| TOTAL = | 48.000 | 6.604E 10 |

Table 2

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * ORIGS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971 , DAY 0138
INCLINAT.= 65 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TD 6160 * PERIOD = 2.148 * VEHICLE =.

HIGH ENERGY

SPECTRUM IN % OF

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 3-5 | 4.419E 10 | 69.924 |
| 5-15 | 1.753E 10 | 27.735 |
| 15-30 | 1.178E 09 | 1.864 |
| 30-50 | 1.614E 08 | 0.287 |
| 50-100 | 5.273E 07 | 0.083 |
| >100 | 6.756E 07 | 0.107 |
| TOTAL = | 6.320E 10 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| 1 | NOT VALID |
| 3 | 6.320E 10 |
| 5 | 1.901E 10 |
| 7 | 8.660E 09 |
| 9 | 4.826E 09 |
| 11 | 3.030E 09 |
| 13 | 2.059E 09 |
| 15 | 1.480E 09 |
| 18 | 9.724E 08 |
| 21 | 6.824E 08 |
| 24 | 5.025E 08 |
| 27 | 3.838E 08 |
| 30 | 3.017E 08 |
| 35 | 2.191E 08 |
| 40 | 1.331E 08 |
| 45 | 8.126E 07 |
| 50 | 1.203E 08 |
| 60 | 1.071E 08 |
| 70 | 9.542E 07 |
| 80 | 8.503E 07 |
| 90 | 7.578E 07 |
| 100 | 6.756E 07 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>5) |
|---|---|---|
| 0.E0-1.E0 | 23.317 | 2.992E 04 |
| 1.E0-1.E1 | 2.333 | 3.552E 04 |
| 1.E1-1.E2 | 1.650 | 1.963E 05 |
| 1.E2-1.E3 | 1.367 | 1.990E 06 |
| 1.E3-1.E4 | 2.317 | 4.059E 07 |
| 1.E4-1.E5 | 4.300 | 6.153E 08 |
| 1.E5-OVER | 12.733 | 3.736E 10 |
| TOTAL = | 48.000 | 3.802E 10 |

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** . NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * ORIGS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971 , DAY 0138
INCLINAT.= 80 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TO 6160 * PERIOD = 2.148 * VEHICLE =.AE-D

HIGH ENERGY

SPECTRUM IN % OF

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 3-5 | 4.127E 10 | 70.029 |
| 5-15 | 1.630E 10 | 27.657 |
| 15-30 | 1.087E 09 | 1.845 |
| 30-50 | 1.703E 08 | 0.289 |
| 50-100 | 4.672E 07 | 0.079 |
| >100 | 5.968E 07 | 0.101 |
| TOTAL = | 5.893E 10 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| 1 | NOT VALID |
| 3 | 5.893E 10 |
| 5 | 1.766E 10 |
| 7 | 8.028E 09 |
| 9 | 4.465E 09 |
| 11 | 2.810E 09 |
| 13 | 1.900E 09 |
| 15 | 1.364E 09 |
| 18 | 8.952E 08 |
| 21 | 6.275E 08 |
| 24 | 4.616E 08 |
| 27 | 3.523E 08 |
| 30 | 2.767E 08 |
| 35 | 1.938E 08 |
| 40 | 1.203E 08 |
| 45 | 7.312E 07 |
| 50 | 1.064E 08 |
| 60 | 9.472E 07 |
| 70 | 8.436E 07 |
| 80 | 7.516E 07 |
| 90 | 6.697E 07 |
| 100 | 5.958E 07 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>5) |
|---|---|---|
| 0.E0-1.E0 | 27.000 | 2.532E 04 |
| 1.E0-1.E1 | 1.650 | 2.504E 04 |
| 1.E1-1.E2 | 1.217 | 1.397E 05 |
| 1.E2-1.E3 | 0.367 | 1.121E 06 |
| 1.E3-1.E4 | 1.833 | 2.936E 07 |
| 1.E4-1.E5 | 3.500 | 5.491E 08 |
| 1.E5-OVER | 11.550 | 3.475E 10 |
| TOTAL = | 48.000 | 3.533E 10 |

TABLE 4

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971, DAY 0138
FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR D1 = VETTE TBLE *** DECAY DATE = YEAR 1967. , MONTH 6. , DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

INCLINAT.= 23 * PERIG.= 150 * APOG.= 4000 KM * BEL ORBIT TAPE TO 6160 * PERIOD = 2.148 * VEHICLE =

SPECTRUM IN % OF

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 0-.5 | 1.320E 12 | 84.49 |
| .5-1 | 1.462E 11 | 9.36 |
| 1-2 | 6.850E 10 | 4.38 |
| 2-3 | 1.946E 10 | 1.25 |
| 3-4 | 5.673E 09 | 0.36 |
| 4-5 | 1.677E 09 | 0.11 |
| 5-6 | 5.114E 08 | 0.03 |
| 6-7 | 1.554E 08 | 0.01 |
| GT.7 | 7.151E 07 | 0.00 |
| TOTAL = | 1.562E 12 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| 0.0 | 1.562E 12 |
| 0.25 | 5.287E 11 |
| 0.50 | 2.423E 11 |
| 0.75 | 1.416E 11 |
| 1.00 | 9.605E 10 |
| 1.25 | 6.882E 10 |
| 1.50 | 4.977E 10 |
| 1.75 | 3.674E 10 |
| 2.00 | 2.755E 10 |
| 2.25 | 1.997E 10 |
| 2.50 | 1.490E 10 |
| 2.75 | 1.099E 10 |
| 3.00 | 8.089E 09 |
| 3.25 | 5.976E 09 |
| 3.50 | 4.411E 09 |
| 3.75 | 3.297E 09 |
| 4.00 | 2.416E 09 |
| 4.25 | 1.821E 09 |
| 4.50 | 1.332E 09 |
| 4.75 | 9.973E 08 |
| 5.00 | 7.384E 08 |
| 5.25 | 5.559E 08 |
| 5.50 | 4.100E 08 |
| 5.75 | 3.056E 08 |
| 6.00 | 2.269E 08 |
| 6.25 | 1.721E 08 |
| 6.50 | 1.279E 08 |
| 6.75 | 9.615E 07 |
| 7.00 | 7.151E 07 |

EXPOSURE INDEX

| INTENSITY RANGES (EL/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.5) |
|---|---|---|
| ZERO FLUX | 10.6 | 1.397E 03 |
| 1.E0-1.E2 | 0.933 | 6.981E 04 |
| 1.E2-1.E3 | 0.550 | 6.353E 05 |
| 1.E3-1.E4 | 0.867 | 1.313E 07 |
| 1.E4-1.E5 | 2.35 | 4.311E 08 |
| 1.E5-1.E6 | 6.97 | 1.155E 10 |
| 1.E6-1.E7 | 25.3 | 4.579E 11 |
| 1.E7-1.E8 | 0.383 | 1.456E 10 |
| 1.E8-INFIN | 0.0 | 0.0 |
| TOTAL = | 48.017 | 4.844E 11 |

TABLE 5

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971, DAY 0138
FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR D1 = VETTE TBLE *** DECAY DATE = YEAR 1967. , MONTH 6. , DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

INCLINAT.= 65 * PERIG.= 150 * APOG.= 4000 KM * BEL ORBIT TAPE TP 6162 * PERIOD = 2.148 * VEHICLE =

SPECTRUM IN % OE

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 0-.5 | 9.242E 11 | 89.62 |
| .5-1 | 7.302E 10 | 7.08 |
| 1-2 | 2.515E 10 | 2.44 |
| 2-3 | 6.489E 09 | 0.63 |
| 3-4 | 1.747E 09 | 0.17 |
| 4-5 | 4.899E 08 | 0.05 |
| 5-6 | 1.364E 08 | 0.01 |
| 6-7 | 3.918E 07 | 0.00 |
| GT.7 | 1.656E 07 | 0.00 |
| TOTAL = | 1.031E 12 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| 0.0 | 1.031E 12 |
| 0.25 | 2.863E 11 |
| 0.50 | 1.071E 11 |
| 0.75 | 5.398E 10 |
| 1.00 | 3.407E 10 |
| 1.25 | 2.359E 10 |
| 1.50 | 1.662E 10 |
| 1.75 | 1.208E 10 |
| 2.00 | 8.918E 09 |
| 2.25 | 6.334E 09 |
| 2.50 | 4.649E 09 |
| 2.75 | 3.374E 09 |
| 3.00 | 2.429E 09 |
| 3.25 | 1.755E 09 |
| 3.50 | 1.271E 09 |
| 3.75 | 9.404E 08 |
| 4.00 | 6.821E 08 |
| 4.25 | 5.013E 08 |
| 4.50 | 3.670E 08 |
| 4.75 | 2.672E 08 |
| 5.00 | 1.922E 08 |
| 5.25 | 1.445E 08 |
| 5.50 | 1.002E 08 |
| 5.75 | 7.654E 07 |
| 6.00 | 5.574E 07 |
| 6.25 | 4.120E 07 |
| 6.50 | 3.021E 07 |
| 6.75 | 2.202E 07 |
| 7.00 | 1.656E 07 |

EXPOSURE INDEX

| INTENSITY RANGES (FL/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.5) |
|---|---|---|
| ZERO FLUX | 14.0 | 2.000E 03 |
| 1.E0-1.E2 | 0.667 | 4.436E 04 |
| 1.E2-1.E3 | 0.900 | 1.893E 06 |
| 1.E3-1.E4 | 5.70 | 9.159E 07 |
| 1.E4-1.E5 | 6.07 | 8.549E 08 |
| 1.E5-1.E6 | 9.45 | 1.335E 10 |
| 1.E6-1.E7 | 11.3 | 1.999E 11 |
| 1.E7-1.E8 | 0.0 | 0.0 |
| 1.E8-INFIN | 0.0 | 0.0 |
| TOTAL = | 48.017 | 2.142E 11 |

Table 6

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971, DAY 0137
FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR D1 = VETTE TBLE *** DECAY DATE = YEAR 1967. , MONTH 6. , DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

INCLINAT.= 80 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TD 6160 * PERIOD = 2.148 * VEHICLE =

SPECTRUM IN % DE

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| 0-.5 | 8.658E 11 | 89.80 |
| .5-1 | 6.715E 10 | 6.96 |
| 1-2 | 2.302E 10 | 2.39 |
| 2-3 | 5.949E 09 | 0.62 |
| 3-4 | 1.603E 09 | 0.17 |
| 4-5 | 4.498E 08 | 0.05 |
| 5-6 | 1.254E 08 | 0.01 |
| 6-7 | 3.603E 07 | 0.00 |
| GT.7 | 1.529E 07 | 0.00 |
| TOTAL = | 9.641E 11 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| 0.0 | 9.641E 11 |
| 0.25 | 2.648E 11 |
| 0.50 | 9.835E 10 |
| 0.75 | 4.944E 10 |
| 1.00 | 3.120E 10 |
| 1.25 | 2.160E 10 |
| 1.50 | 1.522E 10 |
| 1.75 | 1.107E 10 |
| 2.00 | 8.178E 09 |
| 2.25 | 5.808E 09 |
| 2.50 | 4.261E 09 |
| 2.75 | 3.094E 09 |
| 3.00 | 2.229E 09 |
| 3.25 | 1.611E 09 |
| 3.50 | 1.166E 09 |
| 3.75 | 8.633E 08 |
| 4.00 | 6.264E 08 |
| 4.25 | 4.603E 08 |
| 4.50 | 3.333E 08 |
| 4.75 | 2.454E 08 |
| 5.00 | 1.767E 08 |
| 5.25 | 1.329E 08 |
| 5.50 | 9.205E 07 |
| 5.75 | 7.046E 07 |
| 6.00 | 5.132E 07 |
| 6.25 | 3.796E 07 |
| 6.50 | 2.784E 07 |
| 6.75 | 2.026E 07 |
| 7.00 | 1.529E 07 |

EXPOSURE INDEX

| INTENSITY RANGES (EL/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.5) |
|---|---|---|
| ZERO FLUX | 19.5 | 2.019E 03 |
| 1.E0-1.E2 | 0.567 | 4.319E 04 |
| 1.E2-1.E3 | 0.583 | 8.561E 05 |
| 1.E3-1.E4 | 3.97 | 6.269E 07 |
| 1.E4-1.E5 | 5.37 | 7.955E 08 |
| 1.E5-1.E6 | 7.57 | 1.106E 10 |
| 1.E6-1.E7 | 10.5 | 1.848E 11 |
| 1.E7-1.E8 | 0.0 | 0.0 |
| 1.E8-INFIN | 0.0 | 0.0 |
| TOTAL = | 48.017 | 1.967E 11 |

Table 7

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * GRIDS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971, DAY 0138
INCLINAT.= 23 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TD 6160 * PERIOD = 2.148 * VEHICLE =.

LOW ENERGY

SPECTRUM IN % OF

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| .10- .50 | 1.336E 10 | 18.625 |
| .50-1.10 | 1.600E 10 | 22.301 |
| 1.10-2.00 | 1.714E 10 | 23.885 |
| 2.00-3.00 | 1.239E 10 | 17.267 |
| 3.00-4.00 | 7.864E 09 | 10.963 |
| 4.00-5.00 | 4.993E 09 | 6.960 |
| TOTAL = | 7.174E 10 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| .10 | 8.043E 10 |
| .30 | 7.345E 10 |
| .50 | 6.707E 10 |
| .70 | 6.125E 10 |
| .90 | 5.593E 10 |
| 1.10 | 5.107E 10 |
| 1.30 | 4.664E 10 |
| 1.50 | 4.259E 10 |
| 1.75 | 3.802E 10 |
| 2.00 | 3.394E 10 |
| 2.25 | 3.030E 10 |
| 2.50 | 2.704E 10 |
| 2.75 | 2.414E 10 |
| 3.00 | 2.155E 10 |
| 3.25 | 1.924E 10 |
| 3.50 | 1.717E 10 |
| 3.75 | 1.533E 10 |
| 4.00 | 1.369E 10 |
| 4.25 | 1.222E 10 |
| 4.50 | 1.091E 10 |
| 4.75 | 9.737E 09 |
| 5.00 | 8.693E 09 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.1) |
|---|---|---|
| 0.E0-1.E0 | 11.533 | 1.148E 04 |
| 1.E0-1.E1 | 0.067 | 1.029E 03 |
| 1.E1-1.E2 | 0.250 | 4.291E 04 |
| 1.E2-1.E3 | 0.833 | 1.639E 06 |
| 1.E3-1.E4 | 2.083 | 3.554E 07 |
| 1.E4-1.E5 | 4.633 | 7.610E 08 |
| 1.E5-OVER | 28.617 | 1.601E 11 |
| TOTAL = | 48.000 | 1.609E 11 |

Table 8

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * GRIDS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971, DAY 0138
INCLINAT.= 65 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TO 6160 * PERIOD = 2.146 * VEHICLE =.AE-C

LOW ENERGY

SPECTRUM IN % DE

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| .10- .50 | 5.849E 10 | 54.225 |
| .50-1.10 | 1.975E 10 | 18.310 |
| 1.10-2.00 | 1.327E 10 | 12.302 |
| 2.00-3.00 | 8.183E 09 | 7.586 |
| 3.00-4.00 | 5.015E 09 | 4.649 |
| 4.00-5.00 | 3.158E 09 | 2.928 |
| TOTAL = | 1.079E 11 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| .10 | 1.134E 11 |
| .30 | 6.953E 10 |
| .50 | 5.488E 10 |
| .70 | 4.612E 10 |
| .90 | 3.989E 10 |
| 1.10 | 3.512E 10 |
| 1.30 | 3.129E 10 |
| 1.50 | 2.808E 10 |
| 1.75 | 2.471E 10 |
| 2.00 | 2.186E 10 |
| 2.25 | 1.939E 10 |
| 2.50 | 1.724E 10 |
| 2.75 | 1.535E 10 |
| 3.00 | 1.367E 10 |
| 3.25 | 1.219E 10 |
| 3.50 | 1.087E 10 |
| 3.75 | 9.702E 09 |
| 4.00 | 8.658E 09 |
| 4.25 | 7.728E 09 |
| 4.50 | 6.899E 09 |
| 4.75 | 6.159E 09 |
| 5.00 | 5.500E 09 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.1) |
|---|---|---|
| 0.E0-1.E0 | 14.767 | 4.636E 04 |
| 1.E0-1.E1 | 0.0 | 0.0 |
| 1.E1-1.E2 | 0.017 | 7.515E 02 |
| 1.E2-1.E3 | 0.083 | 1.260E 05 |
| 1.E3-1.E4 | 0.717 | 1.277E 07 |
| 1.E4-1.E5 | 1.217 | 2.146E 08 |
| 1.E5-OVER | 31.217 | 2.265E 11 |
| TOTAL = | 48.000 | 2.267E 11 |

Table 9 80

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
.ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * ORIDS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971, DAY 0138
INCLINAT.= 80 * PERIG.= 150 * APOG.= 4000 KM * B&L ORBIT TAPE TO 6160 * PERIOD = 2.148 * VEHICLE =

LOW ENERGY

SPECTRUM IN % OE

| ENERGY RANGES (MEV) | AVERAGED TOTAL FLUX (PER DAY) | SPECTRUM (PER CENT) |
|---|---|---|
| .10- .50 | 5.532E 10 | 54.309 |
| .50-1.10 | 1.873E 10 | 18.384 |
| 1.10-2.00 | 1.251E 10 | 12.278 |
| 2.00-3.00 | 7.669E 09 | 7.528 |
| 3.00-4.00 | 4.690E 09 | 4.605 |
| 4.00-5.00 | 2.951E 09 | 2.897 |
| TOTAL = | 1.019E 11 | 100.00 |

COMPOSITE ORBIT SPECTRUM

| ENERGY GRTR.THAN (MEV) | AVERAGED INTEG.FLUX (PER DAY) |
|---|---|
| .10 | 1.070E 11 |
| .30 | 6.557E 10 |
| .50 | 5.167E 10 |
| .70 | 4.337E 10 |
| .90 | 3.746E 10 |
| 1.10 | 3.295E 10 |
| 1.30 | 2.932E 10 |
| 1.50 | 2.630E 10 |
| 1.75 | 2.313E 10 |
| 2.00 | 2.044E 10 |
| 2.25 | 1.813E 10 |
| 2.50 | 1.611E 10 |
| 2.75 | 1.434E 10 |
| 3.00 | 1.277E 10 |
| 3.25 | 1.139E 10 |
| 3.50 | 1.015E 10 |
| 3.75 | 9.059E 09 |
| 4.00 | 8.094E 09 |
| 4.25 | 7.316E 09 |
| 4.50 | 6.440E 09 |
| 4.75 | 5.749E 09 |
| 5.00 | 5.133E 09 |

EXPOSURE INDEX

| INTENSITY RANGES (PT/CM**2/SEC) | DURATION OF EXPOSURE (HRS) | TOTAL NO. OF ACCUMULATED PARTICLES (E>.1) |
|---|---|---|
| 0.E0-1.E0 | 20.200 | 6.384E 04 |
| 1.E0-1.E1 | 0.017 | 5.970E 02 |
| 1.E1-1.E2 | 0.083 | 8.760E 03 |
| 1.E2-1.E3 | 0.167 | 1.866E 05 |
| 1.E3-1.E4 | 0.433 | 7.650E 06 |
| 1.E4-1.E5 | 0.967 | 1.295E 08 |
| 1.E5-OVER | 26.250 | 2.138E 11 |
| TOTAL = | 48.000 | 2.140E 11 |

Figure 2

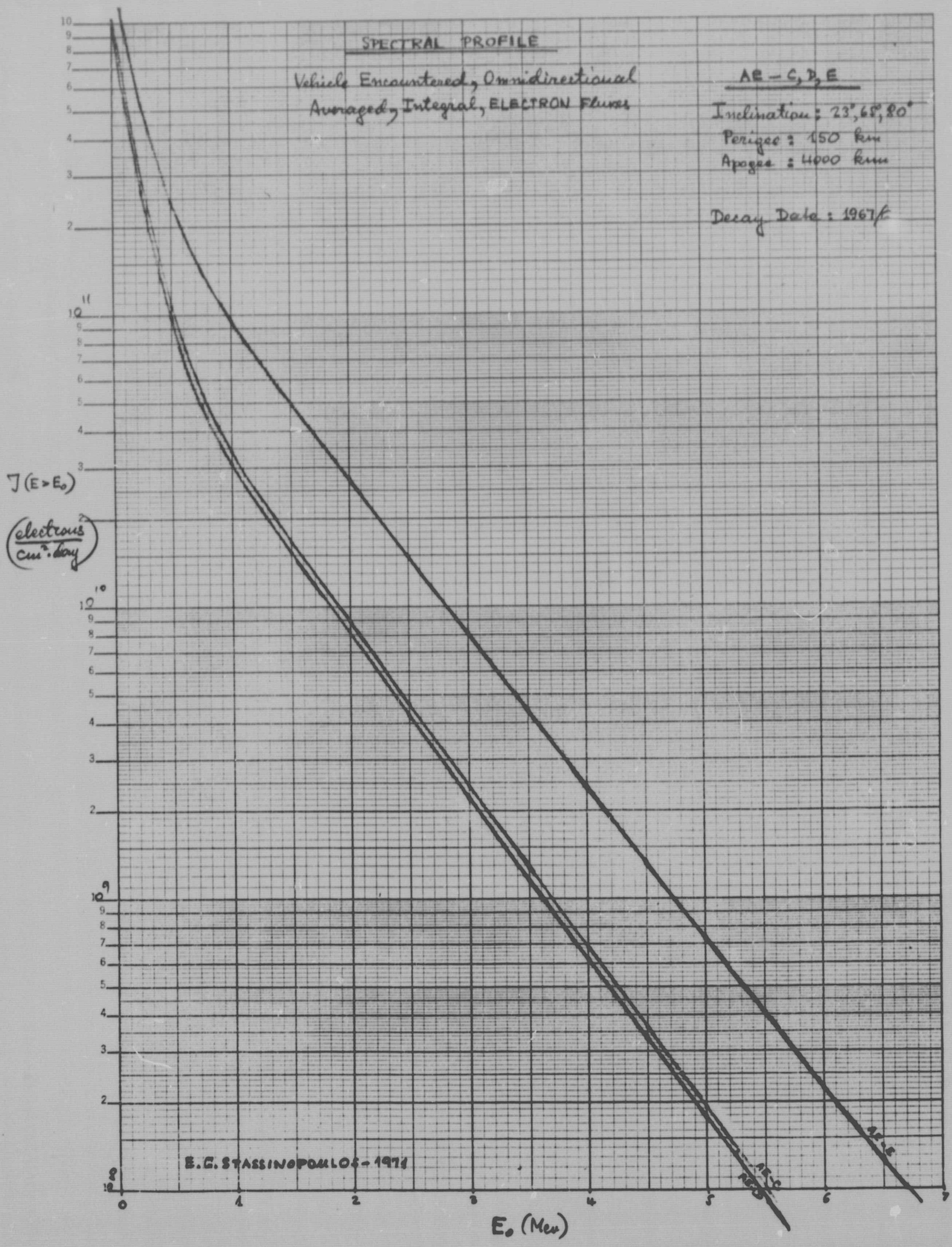
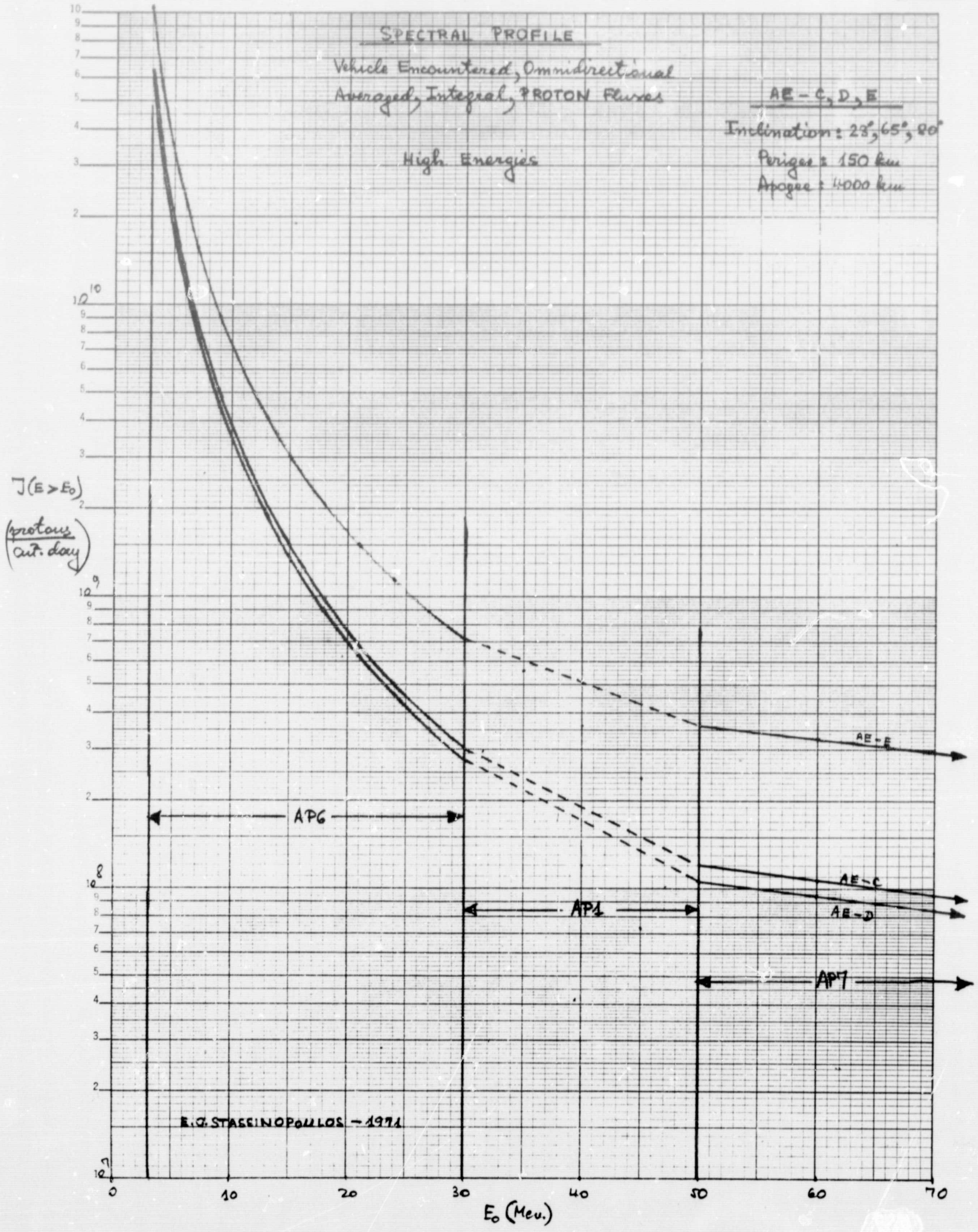

SPECTRAL PROFILE
Vehicle Encountered, Omnidirectional
Averaged, Integral, ELECTRON Fluxes
AE – C, D, E
Inclination: 23°, 68°, 80°
Perigee: 150 km
Apogee: 4000 km
Decay Date: 1967/E
J (E > E₀)
(electrons / cm². day)
E₀ (Mev)
AE-C
AE-D
AE-E
E. G. STASSINOPOULOS – 1971

Figure 2



SPECTRAL PROFILE
Vehicle Encountered, Omnidirectional
Averaged, Integral, PROTON Fluxes
High Energies
AE - C, D, E
Inclination: 28°, 65°, 80°
Perigee: 150 km
Apogee: 4000 km
J(E > E0)
(protons / cm². day)
AE-E
AE-C
AE-D
AP6
AP1
AP7
E.G. STASSINOPOULOS - 1971
E0 (Mev.)

Figure 2A

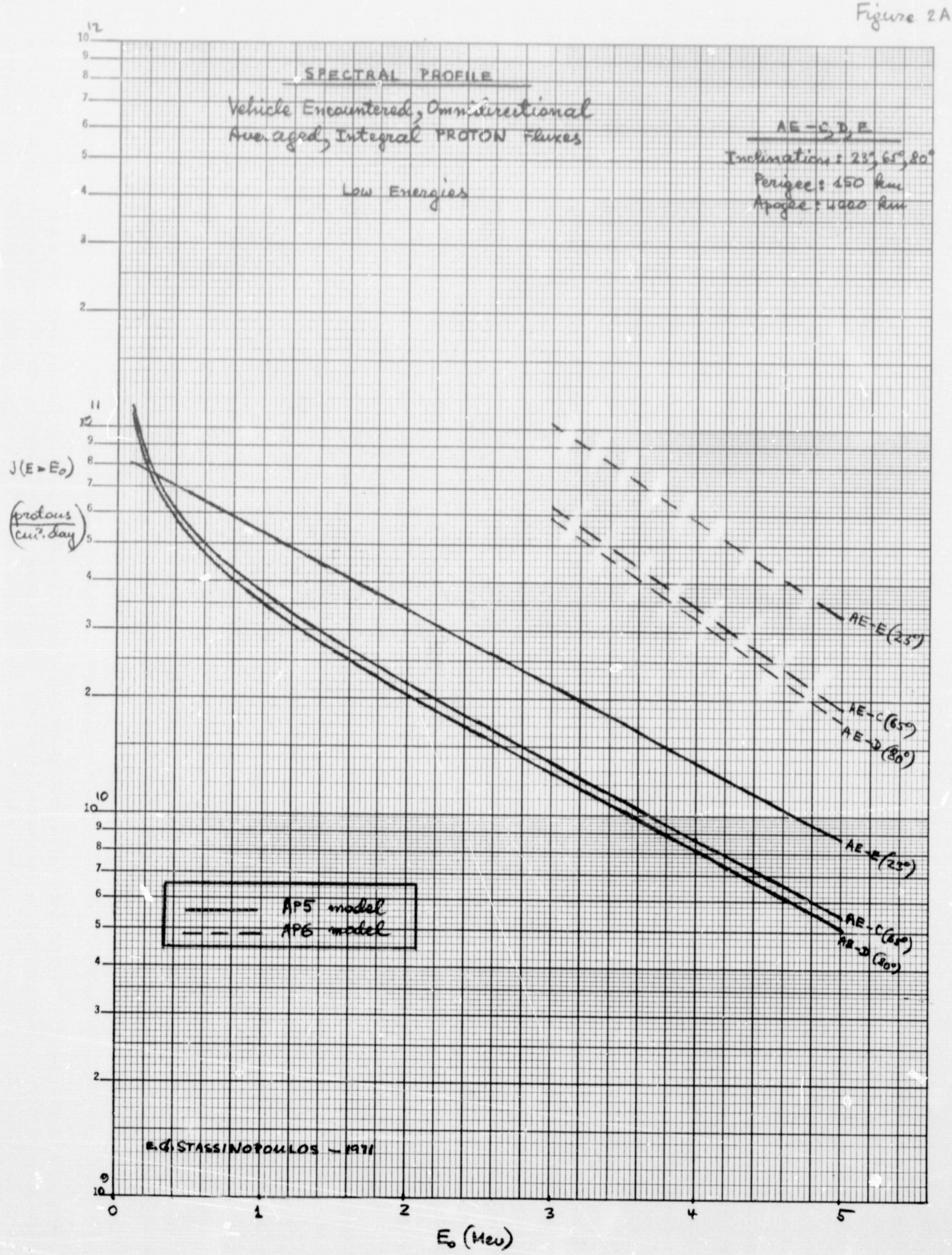
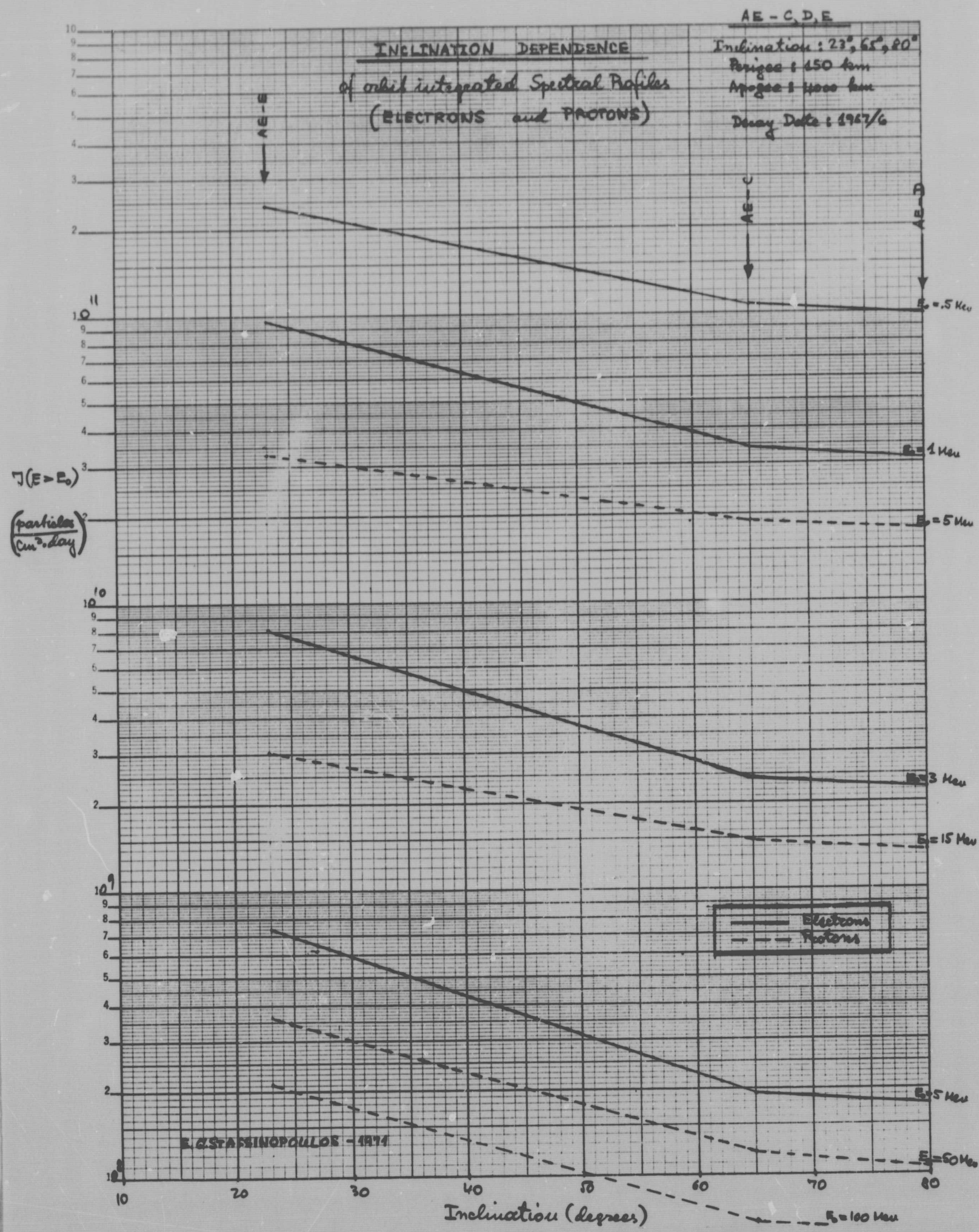

SPECTRAL PROFILE
Vehicle Encountered, Omnidirectional
Averaged, Integral PROTON Fluxes
Low Energies
AE – C, D, E
Inclination: 23°, 65°, 80°
Perigee: 150 km
Apogee: 4000 km
J(E > E₀)
(protons / cm². day)
AE-E (23°)
AE-C (65°)
AE-D (80°)
AE-E (23°)
AE-C (65°)
AE-D (80°)
AP5 model
AP6 model
E.G. STASSINOPOULOS – 1971
E₀ (Mev)

Figure 3


INCLINATION DEPENDENCE
of orbit integrated Spectral Profiles
(ELECTRONS and PROTONS)
AE - C, D, E
Inclination: 23°, 65°, 80°
Perigee: 150 km
Apogee: 4000 km
Decay Date: 1967/6
AE-E
AE-C
AE-D
J(E > E₀)
(particles / cm²·day)
E₀ = .5 Mev
E₀ = 1 Mev
E₀ = 5 Mev
E₀ = 3 Mev
E₀ = 15 Mev
E₀ = 5 Mev
E₀ = 50 Mev
E₀ = 100 Mev
Electrons
Protons
E.G. STASSINOPOULOS - 1971
Inclination (degrees)
10
20
30
40
50
60
70
80

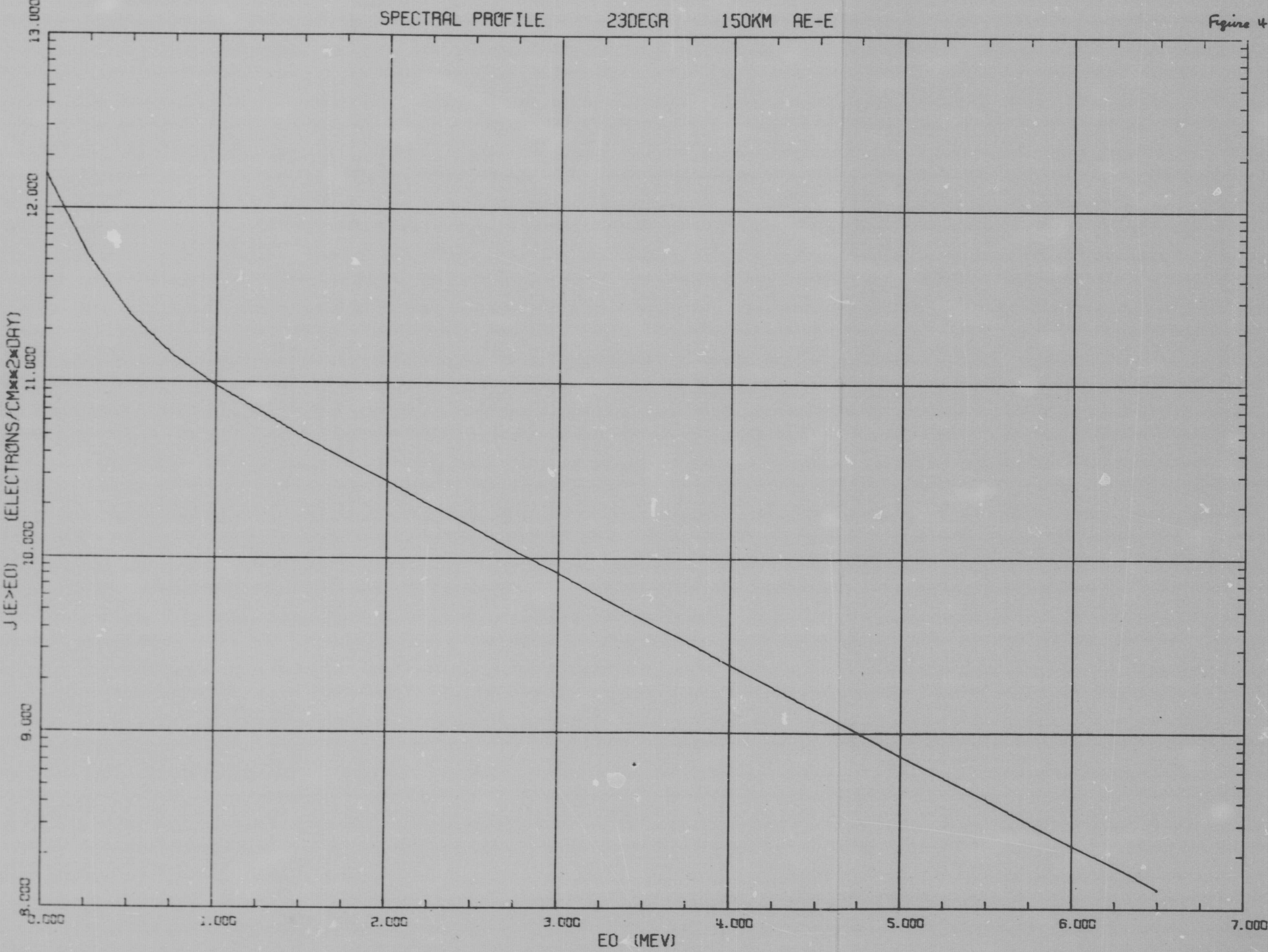
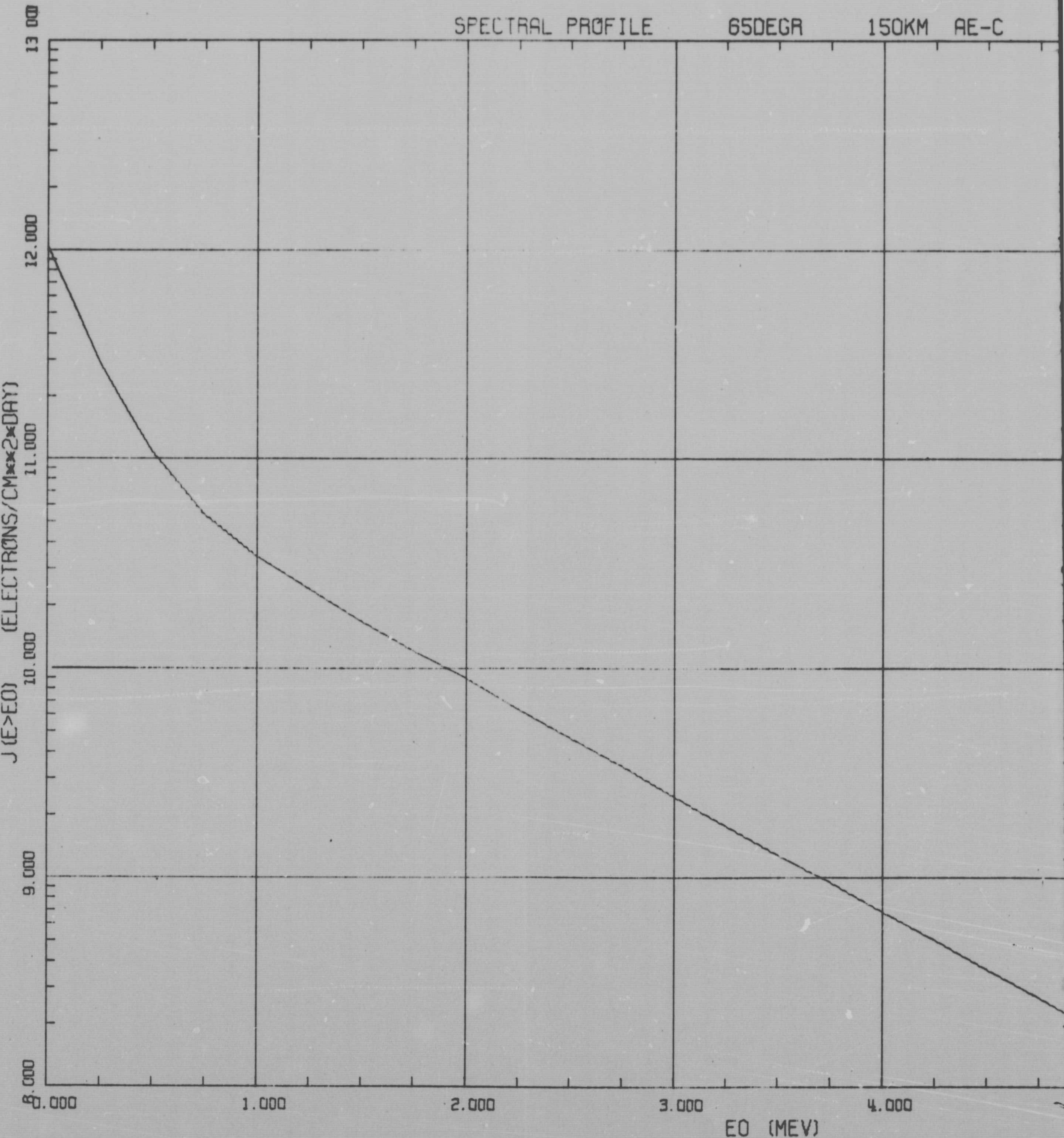

SPECTRAL PROFILE 23DEGR 150KM AE-E
J(E>E0) (ELECTRONS/CM**2*DAY)
E0 (MEV)
8.000
9.000
10.000
11.000
12.000
13.000
0.000
1.000
2.000
3.000
4.000
5.000
6.000
7.000

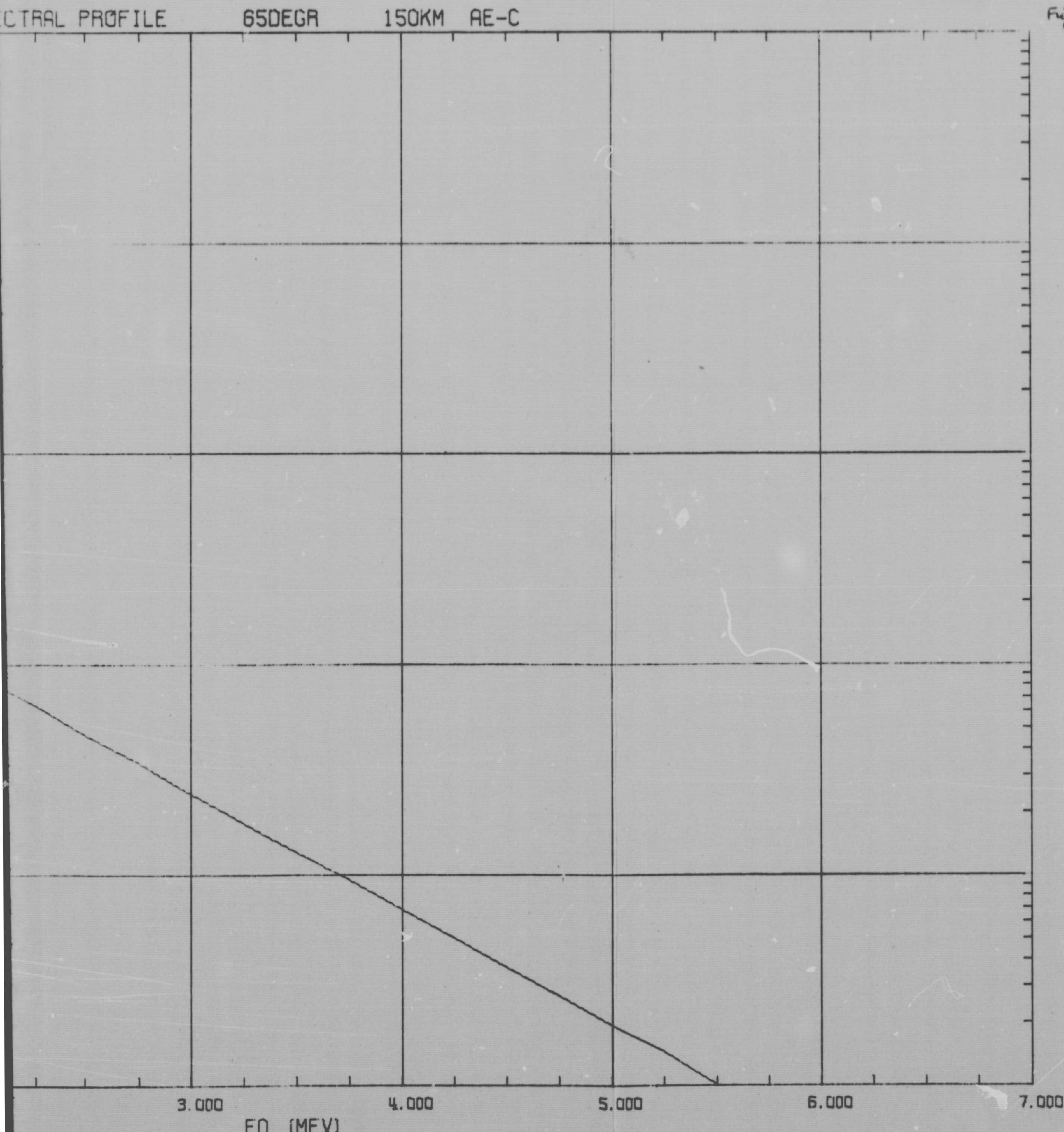
Figure 4

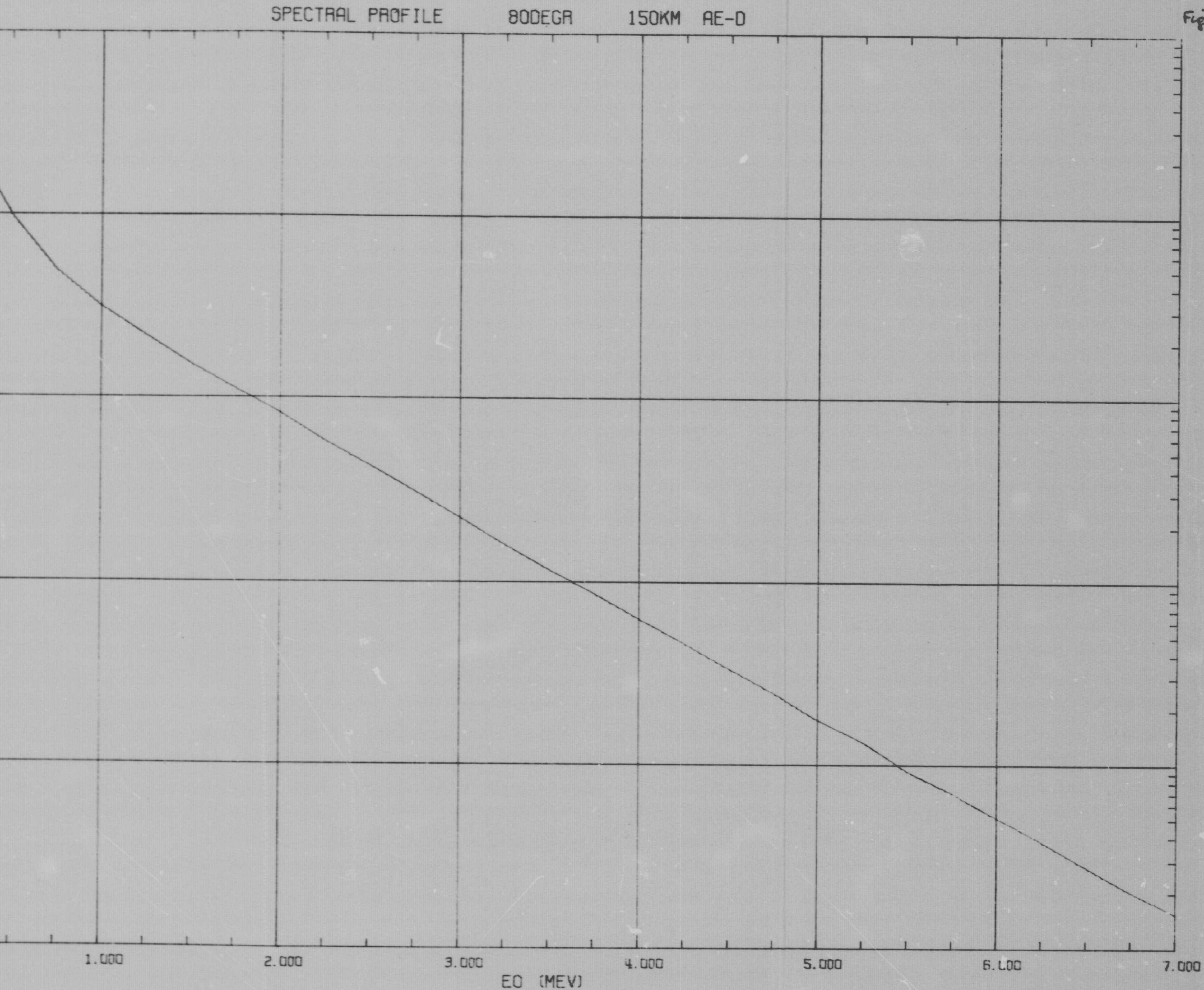
FOLDOUT FRAME 1



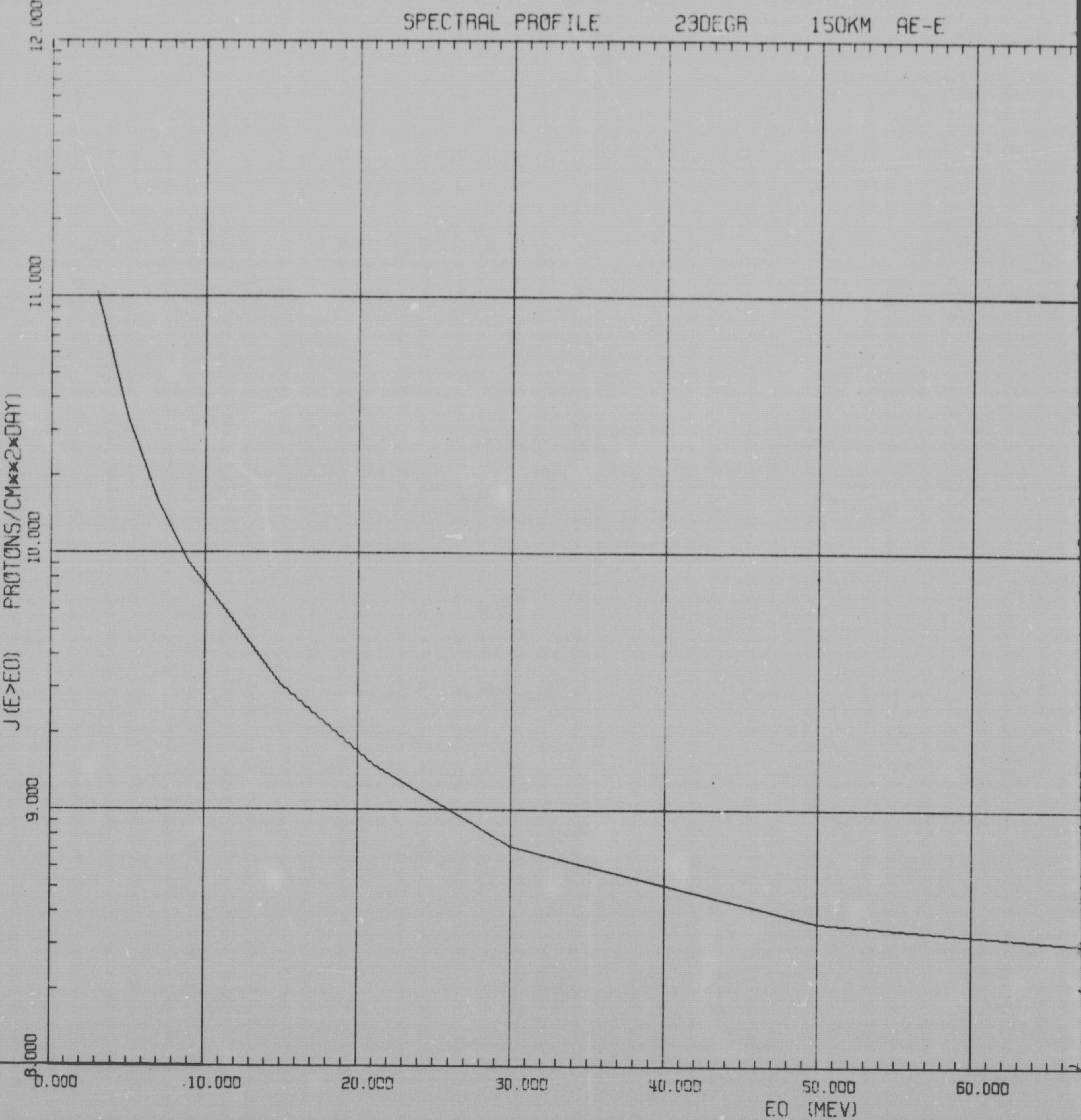
FOLDOUT FRAME 2

Figure 5



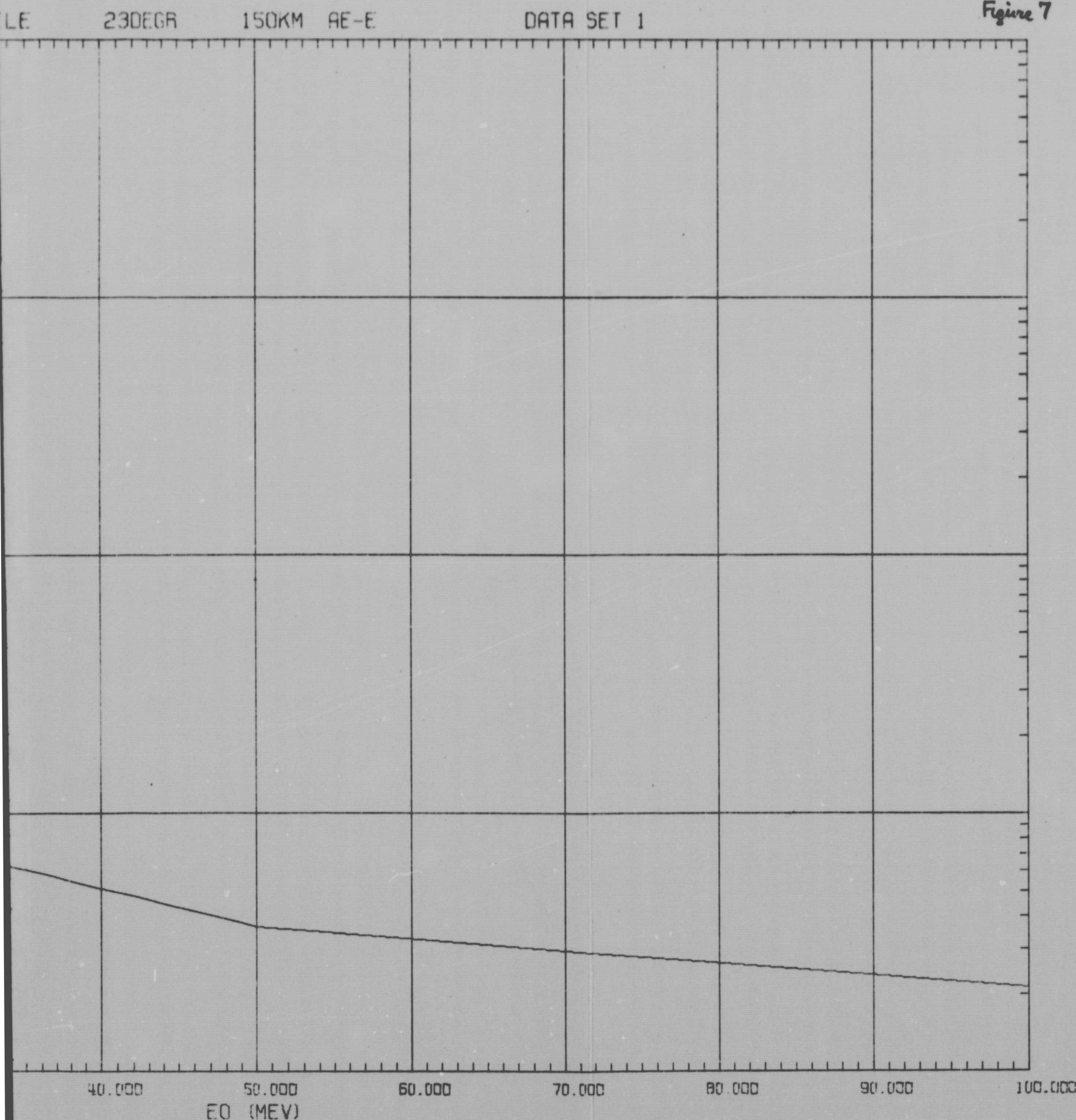

SPECTRAL PROFILE 80DEGR 150KM AE-D
1.000
2.000
3.000
4.000
5.000
6.L00
7.000
EO (MEV)
Figure 6

FOLDOUT FRAME 1

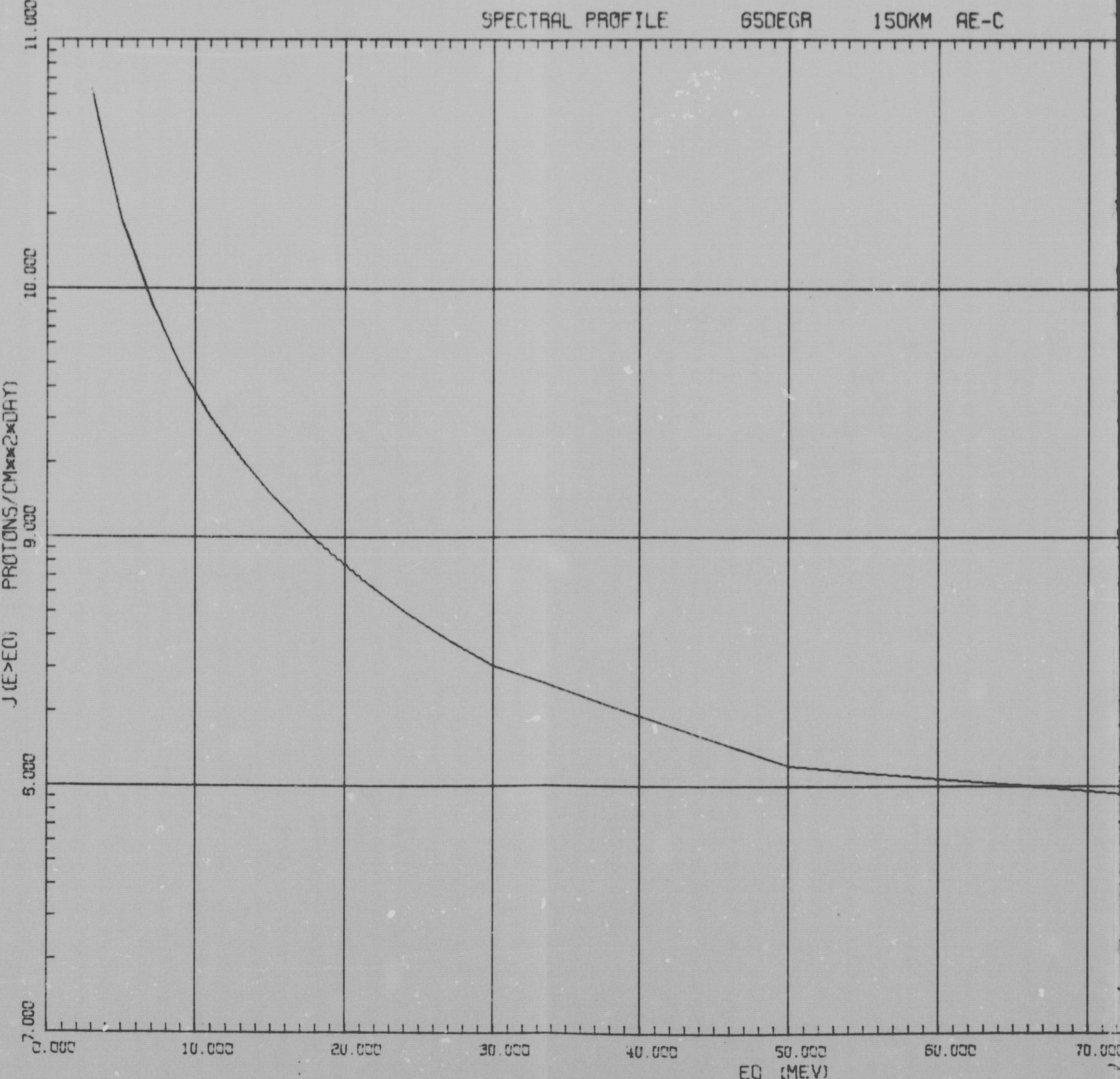


FOLDOUT FRAME 2

Figure 7

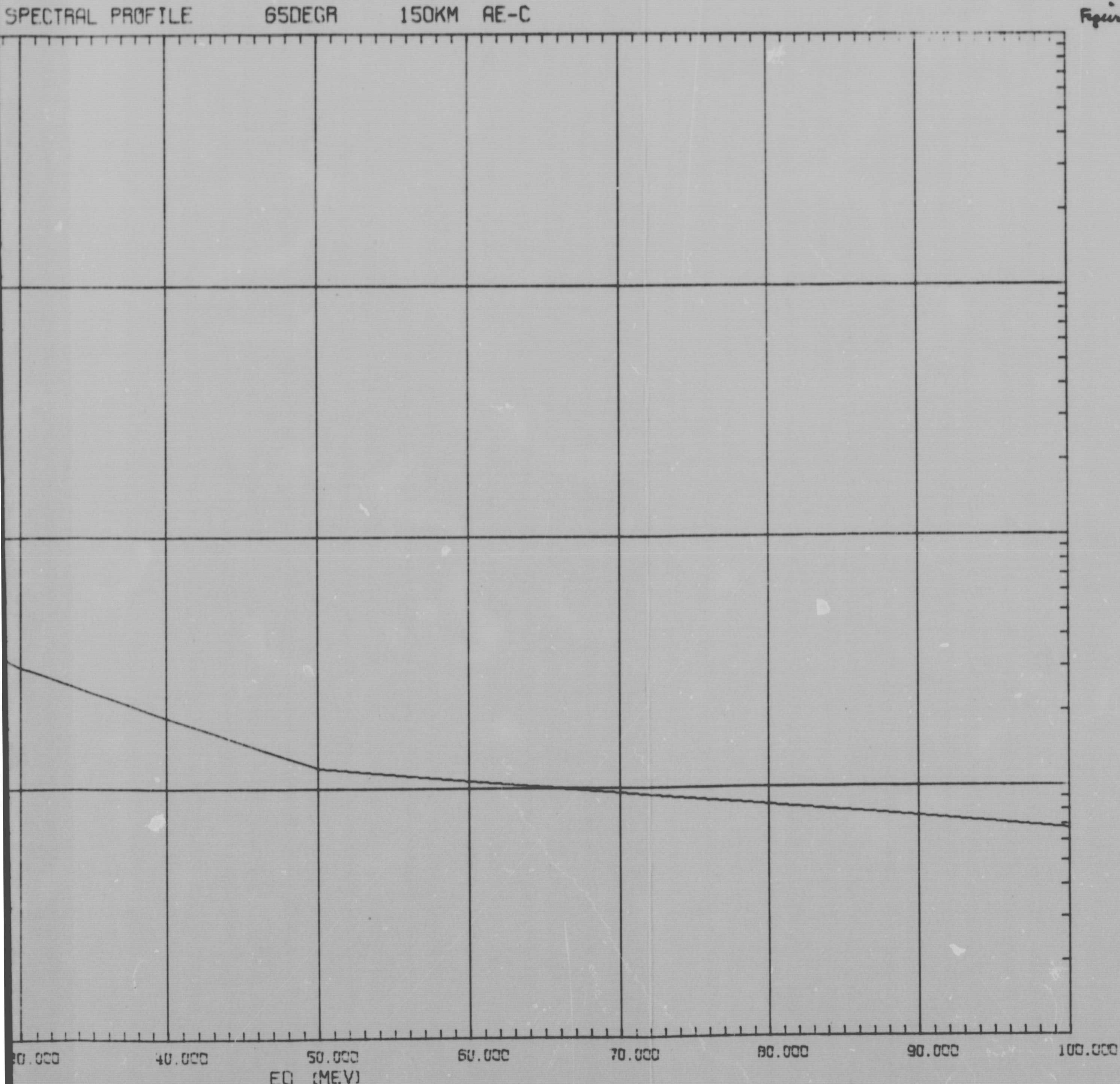


FOLDOUT FRAME 1

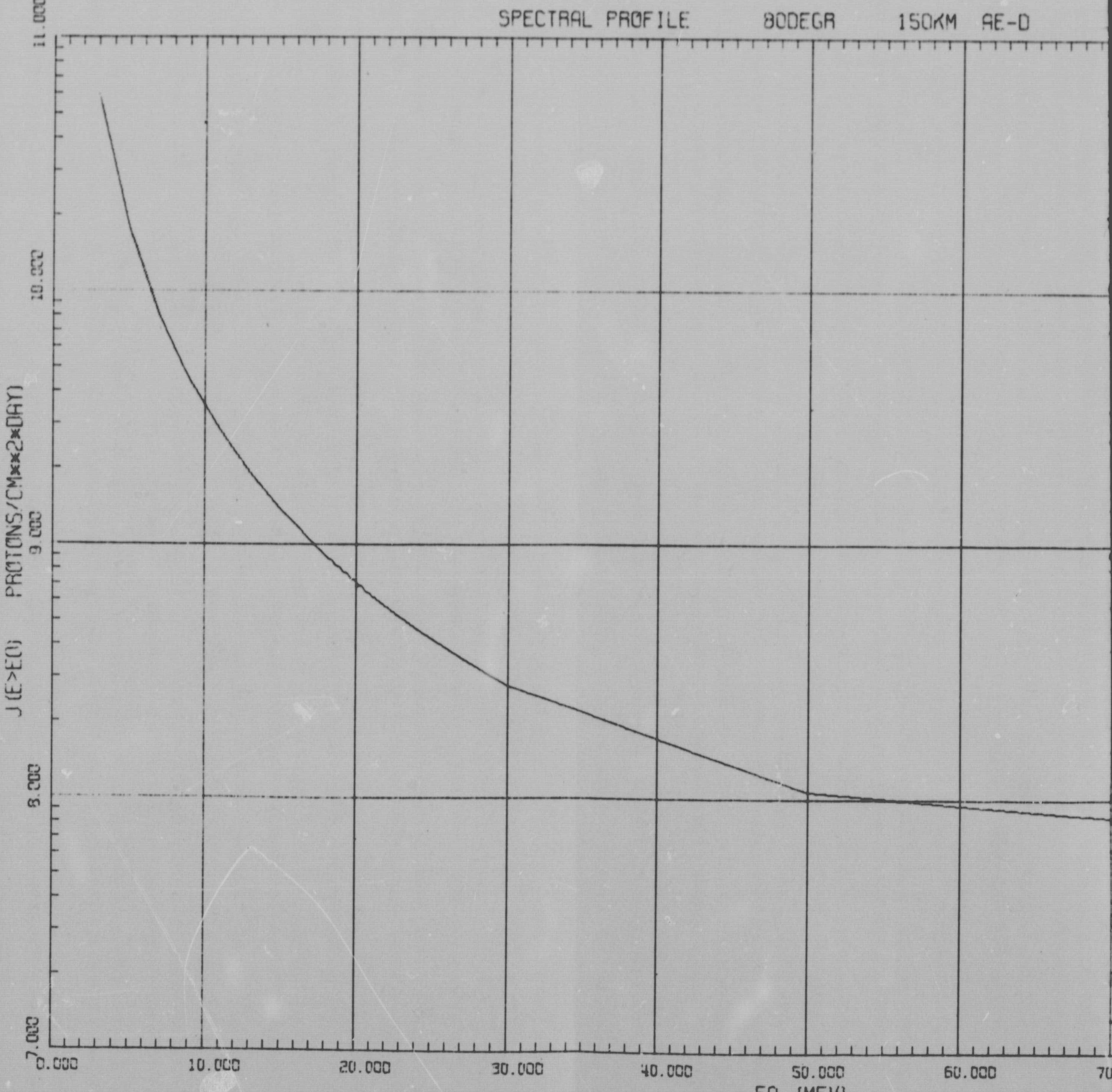


FOLDOUT FRAME 2

Figure 8



FOLDOUT FRAME 1



FOLDOUT FRAME 2

Figure 9

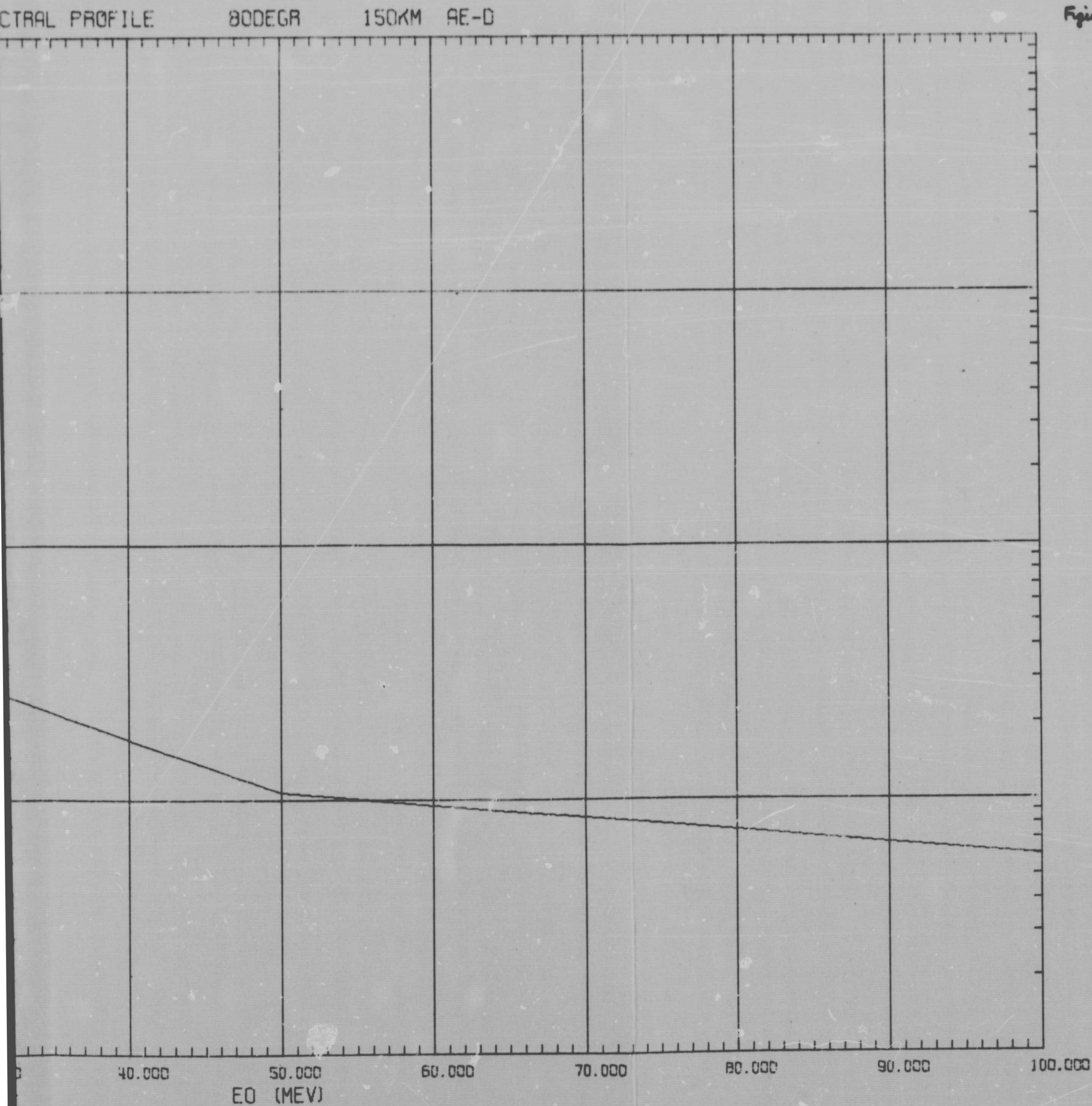
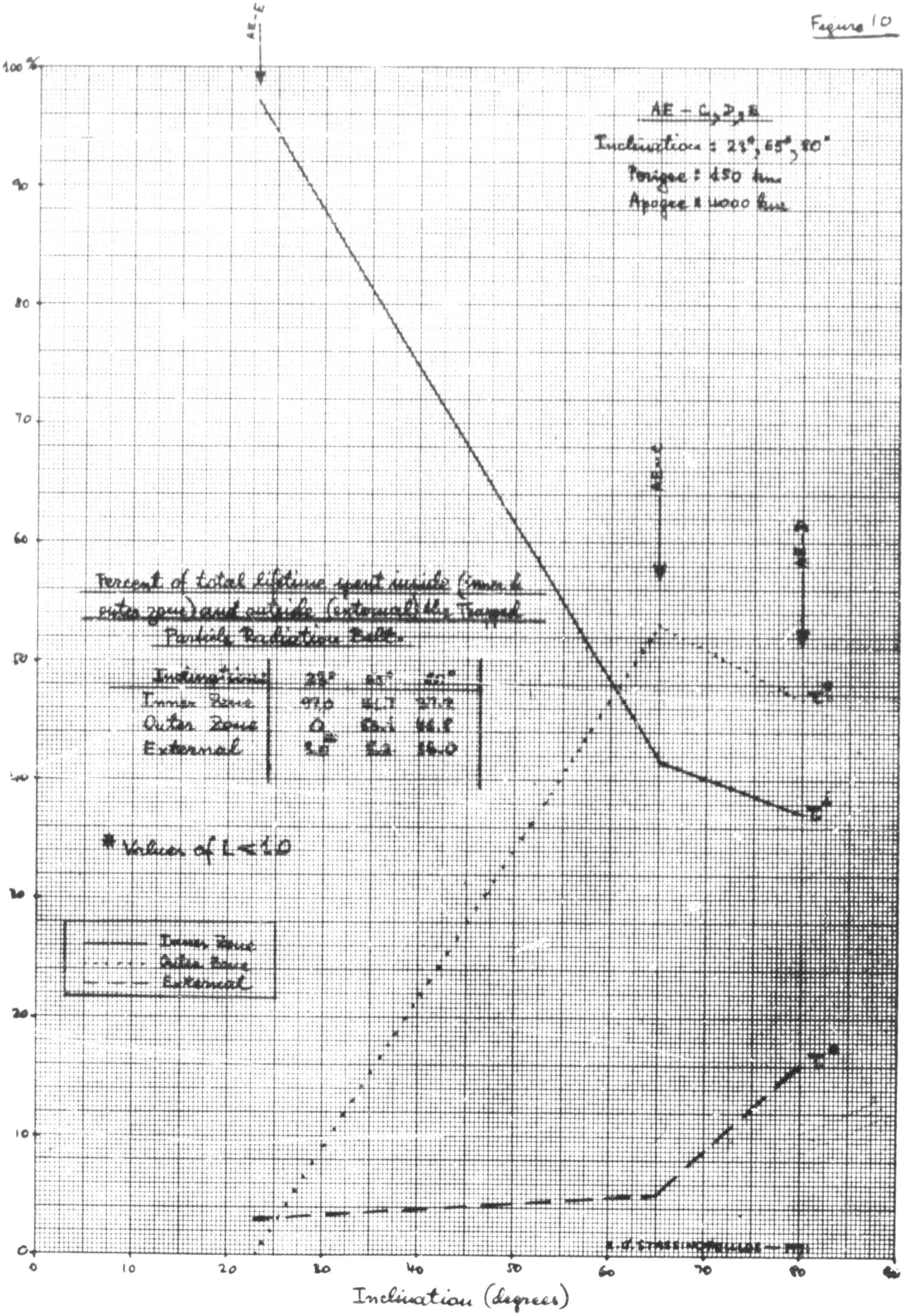
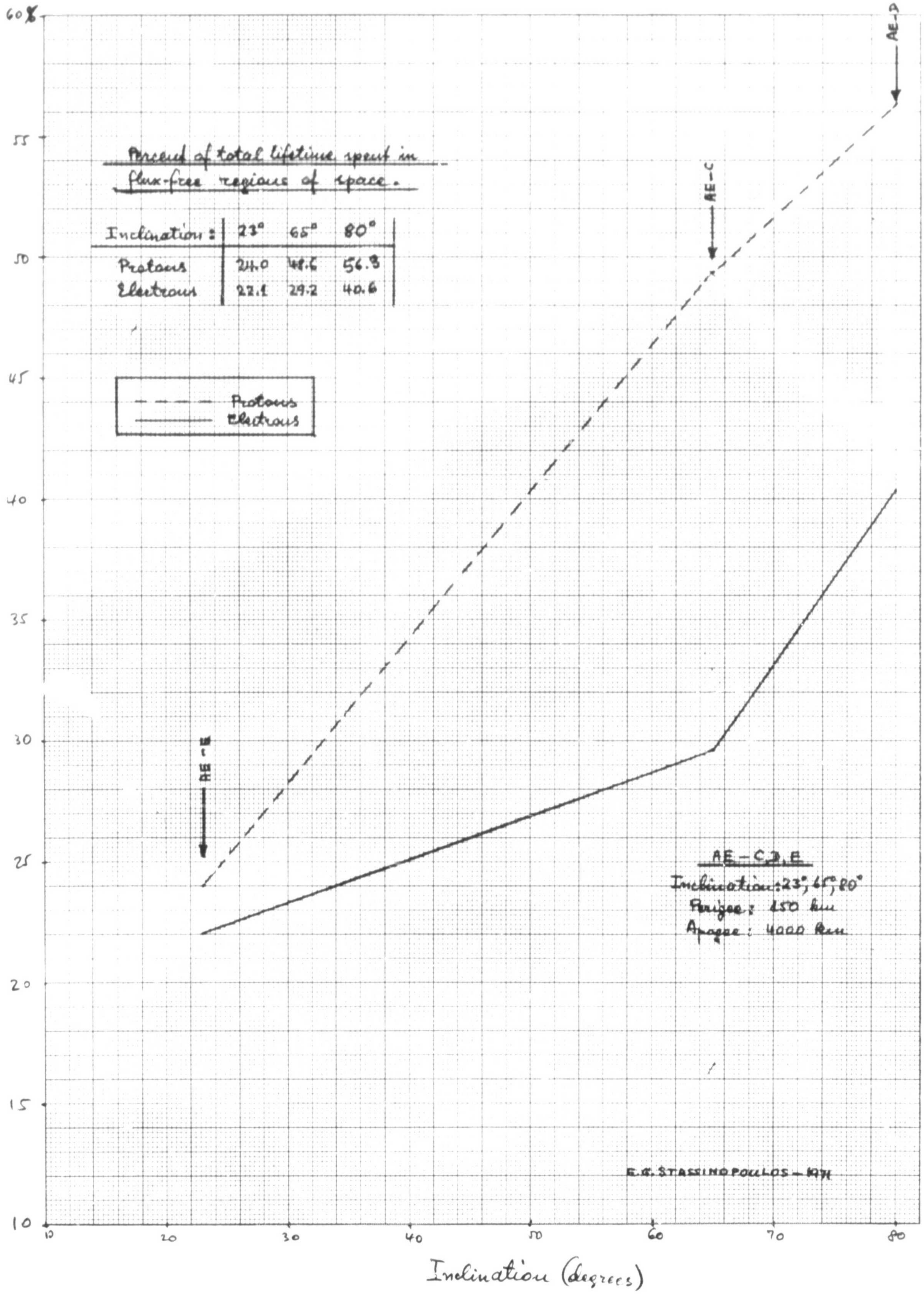


Figure 10



AE-E
AE-C
AE-D
AE - C, D, E
Inclination : 23°, 65°, 80°
Perigee : 450 km
Apogee : 4000 km
Percent of total lifetime spent inside (inner & outer zone) and outside (external) the Trapped Particle Radiation Belt.
Inclination | 23° | 65° | 80°
Inner Zone | 97.0 | 41.7 | 37.2
Outer Zone | 0 | 53.1 | 46.8
External | 3.0 | 5.2 | 16.0
* Values of L < 1.0
Inner Zone
Outer Zone
External
100 %
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
Inclination (degrees)


Percent of total lifetime spent in flux-free regions of space.
Inclination: 23° 65° 80°
Protons 24.0 48.6 56.3
Electrons 22.1 29.2 40.6
Protons
Electrons
AE-D
AE-C
AE-E
AE-C,D,E
Inclination: 23°, 65°, 80°
Perigee: 150 km
Apogee: 4000 km
E.G. STASSINOPOULOS - 1971
60%
55
50
45
40
35
30
25
20
15
10
10
20
30
40
50
60
70
80
Inclination (degrees)

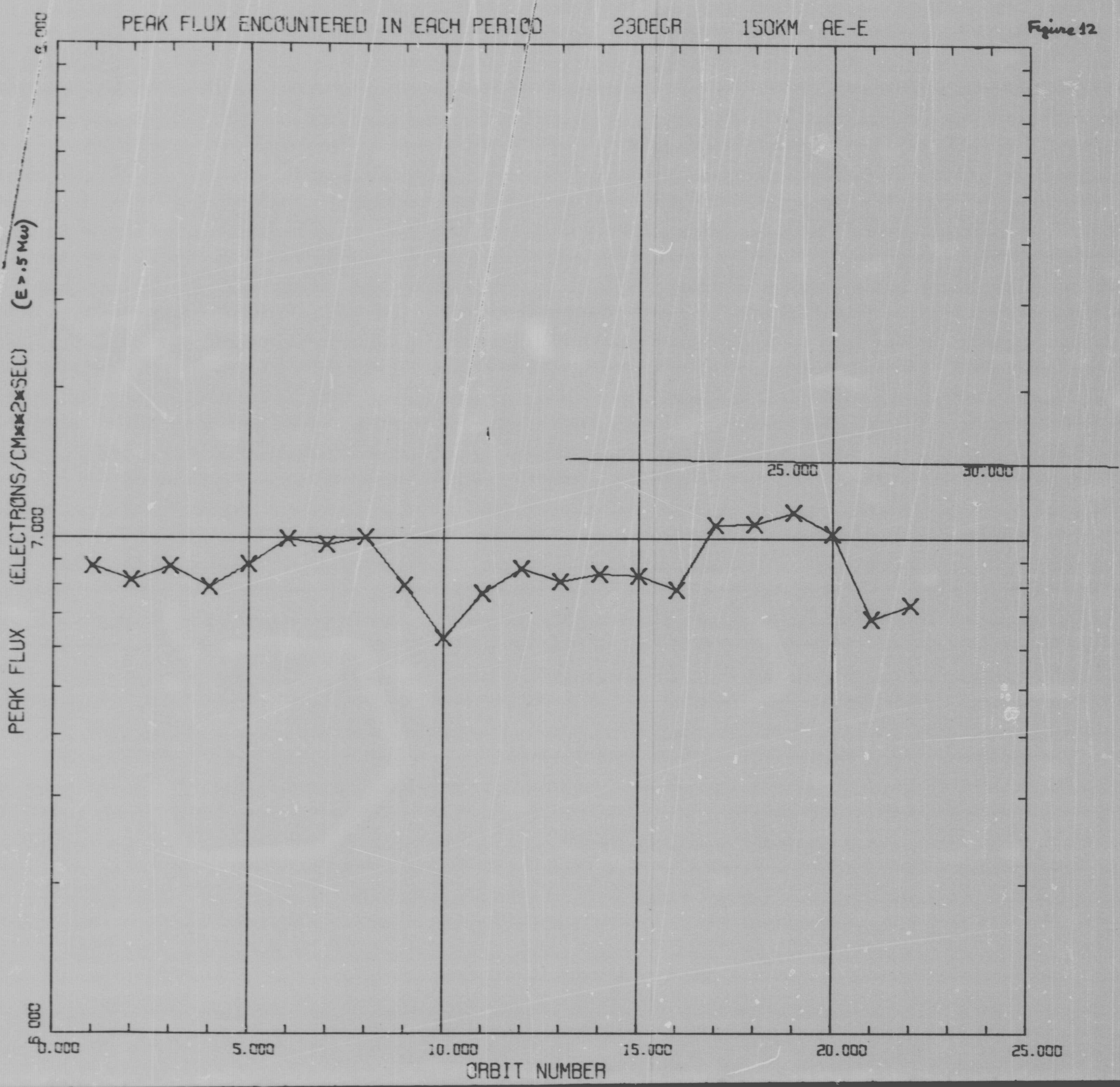

PEAK FLUX ENCOUNTERED IN EACH PERIOD 23DEGR 150KM AE-E
PEAK FLUX (ELECTRONS/CM**2*SEC) (E>.5 Mev)
8.000
7.000
6.000
0.000
5.000
10.000
15.000
20.000
25.000
30.000
ORBIT NUMBER

Figure 12

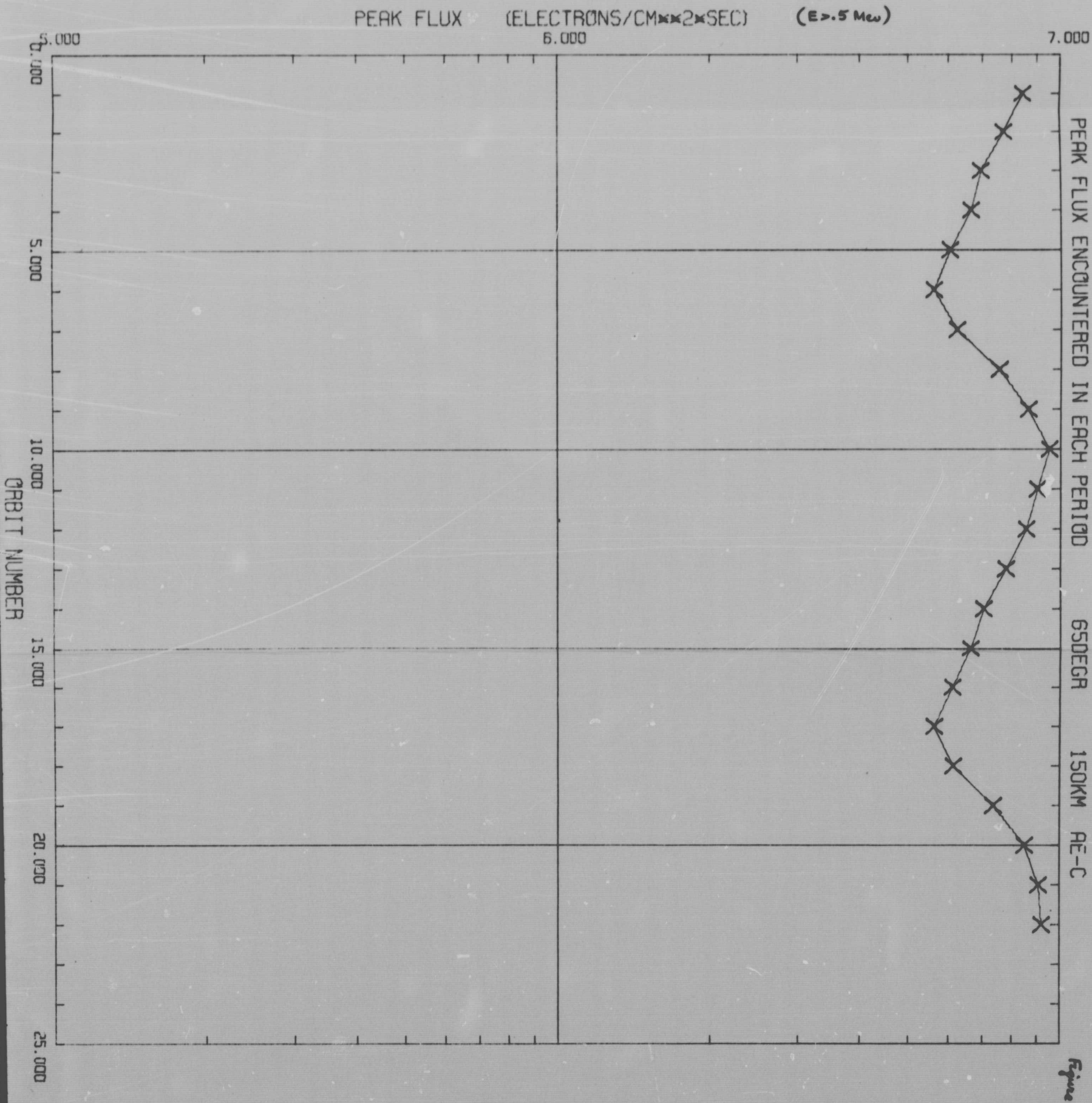
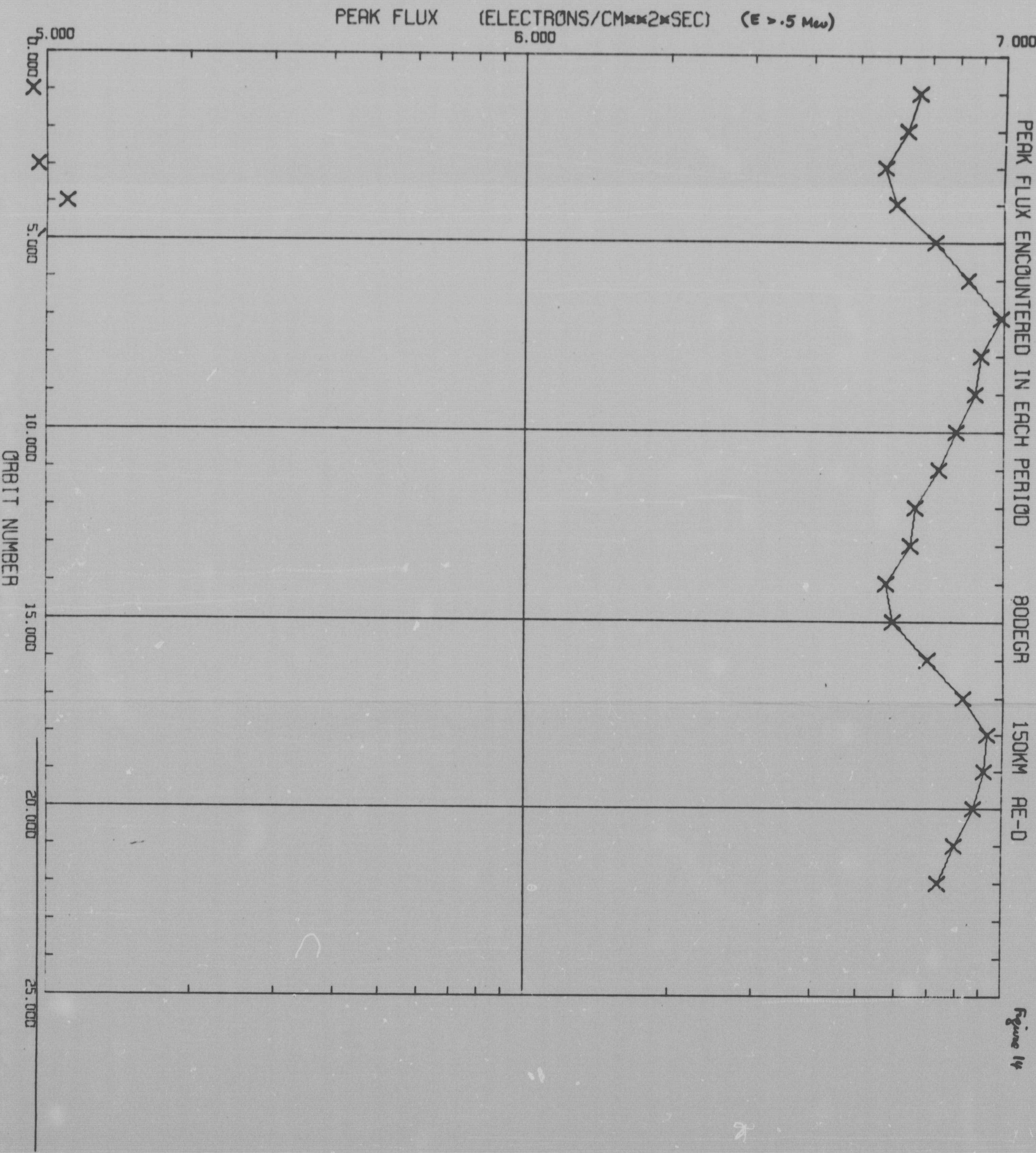

PEAK FLUX (ELECTRONS/CM**2*SEC) (E>.5 Mev)
5.000
6.000
7.000
0.000
5.000
10.000
15.000
20.000
25.000
ORBIT NUMBER
PEAK FLUX ENCOUNTERED IN EACH PERIOD 65DEGR 150KM AE-C

Figure 13


PEAK FLUX (ELECTRONS/CM**2*SEC) (E > .5 Mev)
5.000
6.000
7.000
PEAK FLUX ENCOUNTERED IN EACH PERIOD 80DEGR 150KM AE-D
0.000
5.000
10.000
15.000
20.000
25.000
ORBIT NUMBER
Figure 14

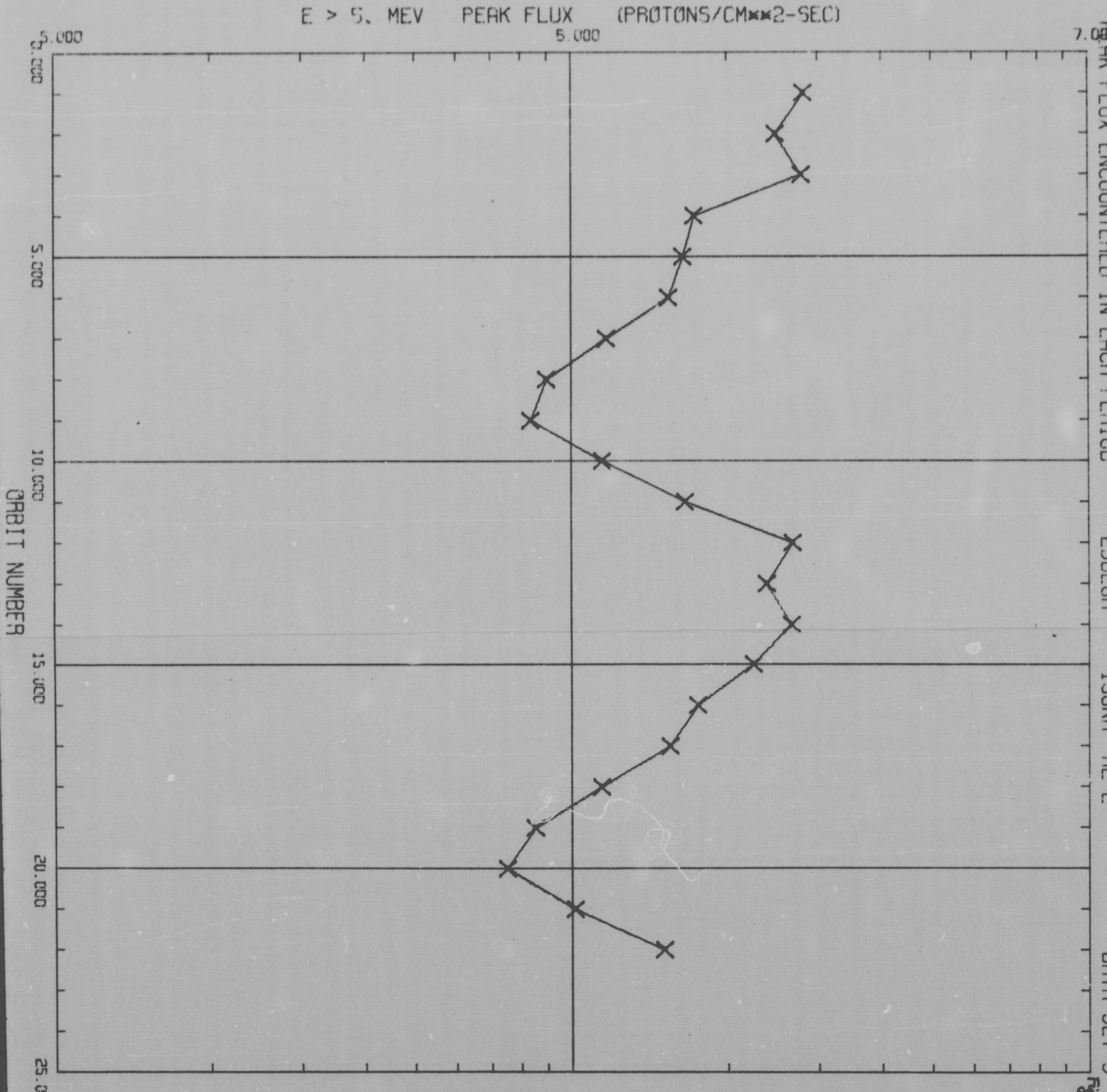

E > 5. MEV PEAK FLUX (PROTONS/CM**2-SEC)
5.000
PEAK FLUX ENCOUNTERED IN EACH PERIOD
230EGR
150KM
AE-E
DATA SET 3
ORBIT NUMBER
5.000
10.000
15.000
20.000
25.000

Fig. 15

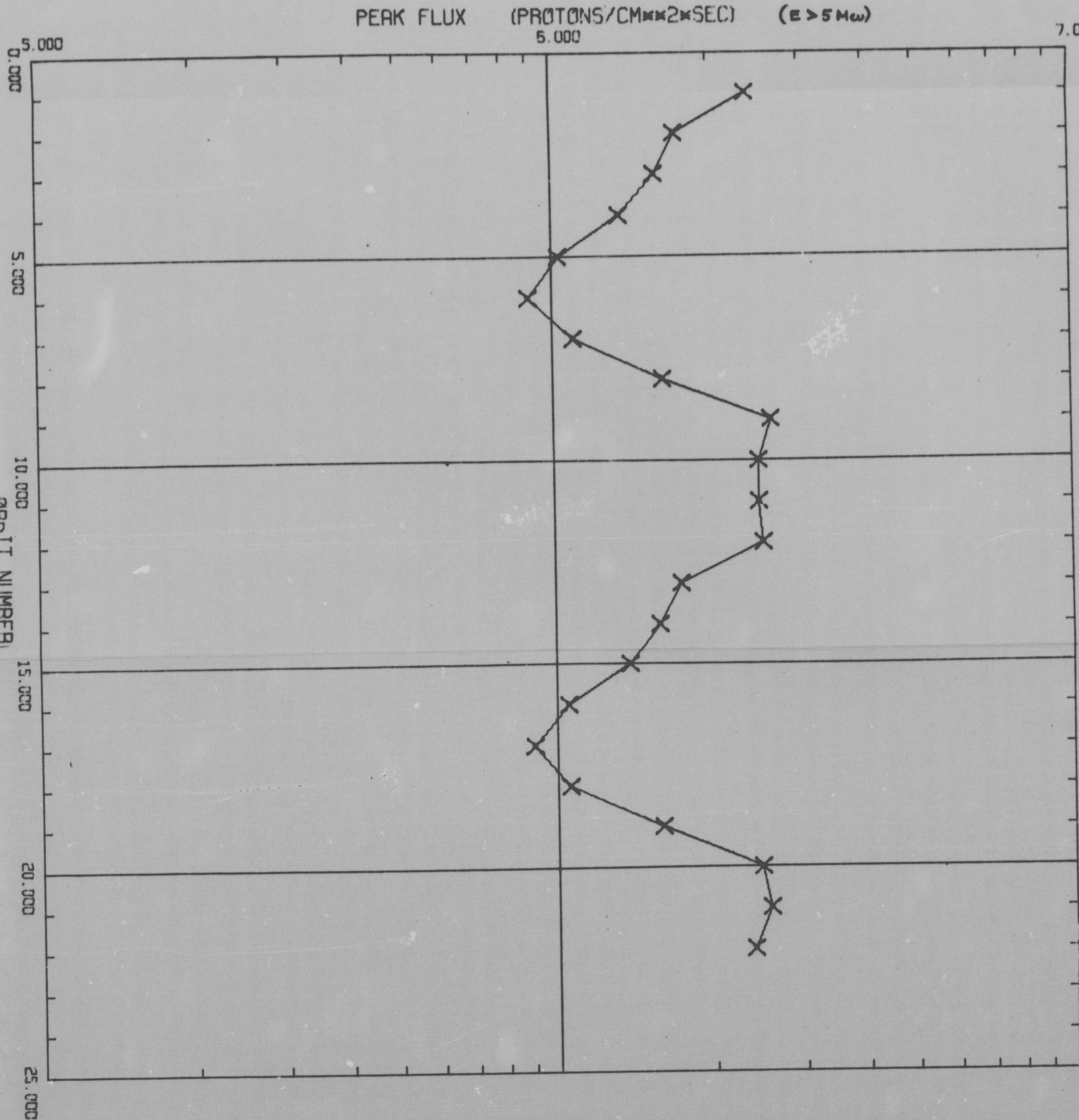

PEAK FLUX (PROTONS/CM**2*SEC) (E>5 Mev)
5.000
6.000
7.000
0.000
5.000
10.000
15.000
20.000
25.000
ORBIT NUMBER
PEAK FLUX ENCOUNTERED IN EACH PERIOD 65DEGR 150KM AE-C

Figure 16

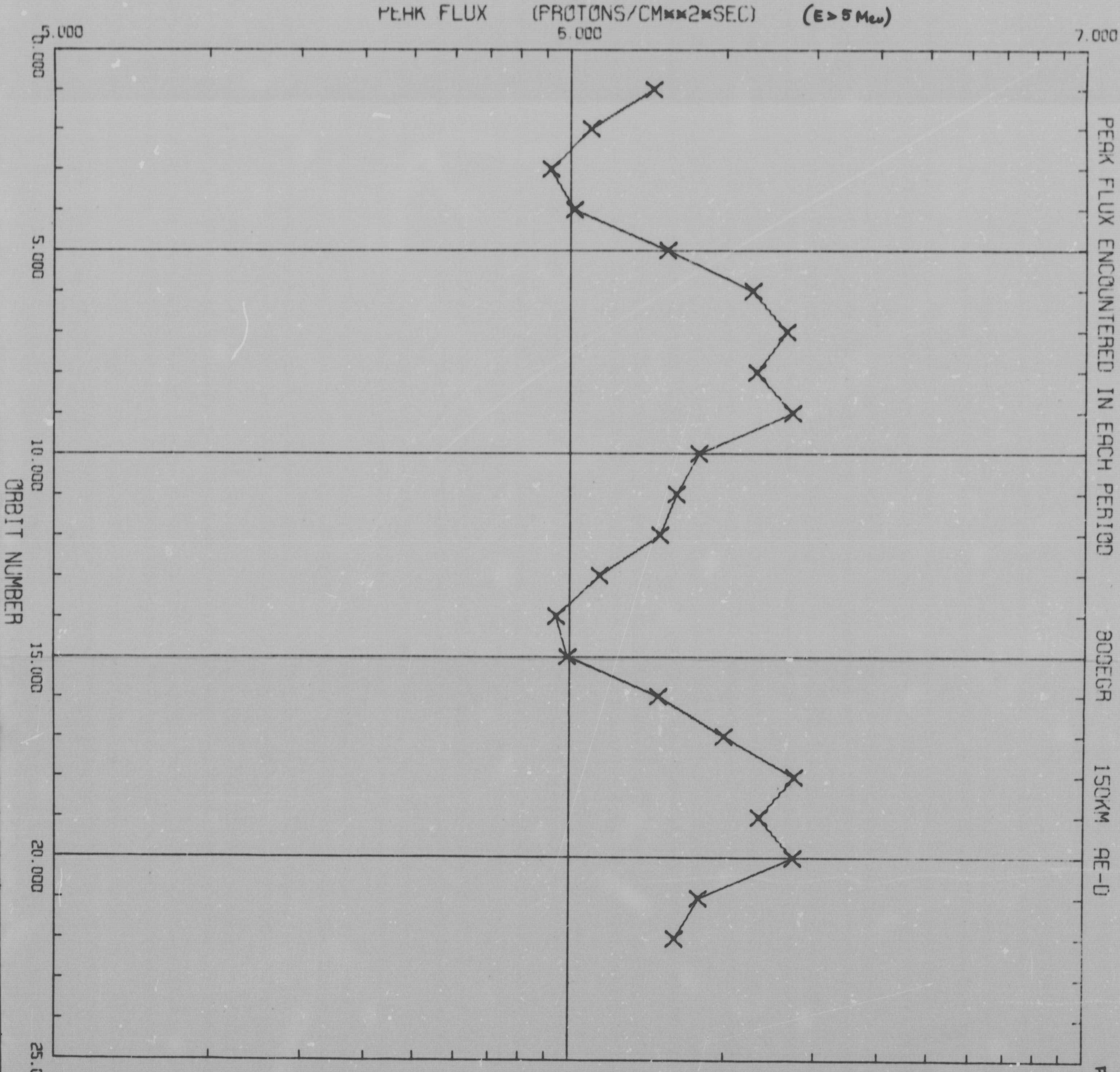
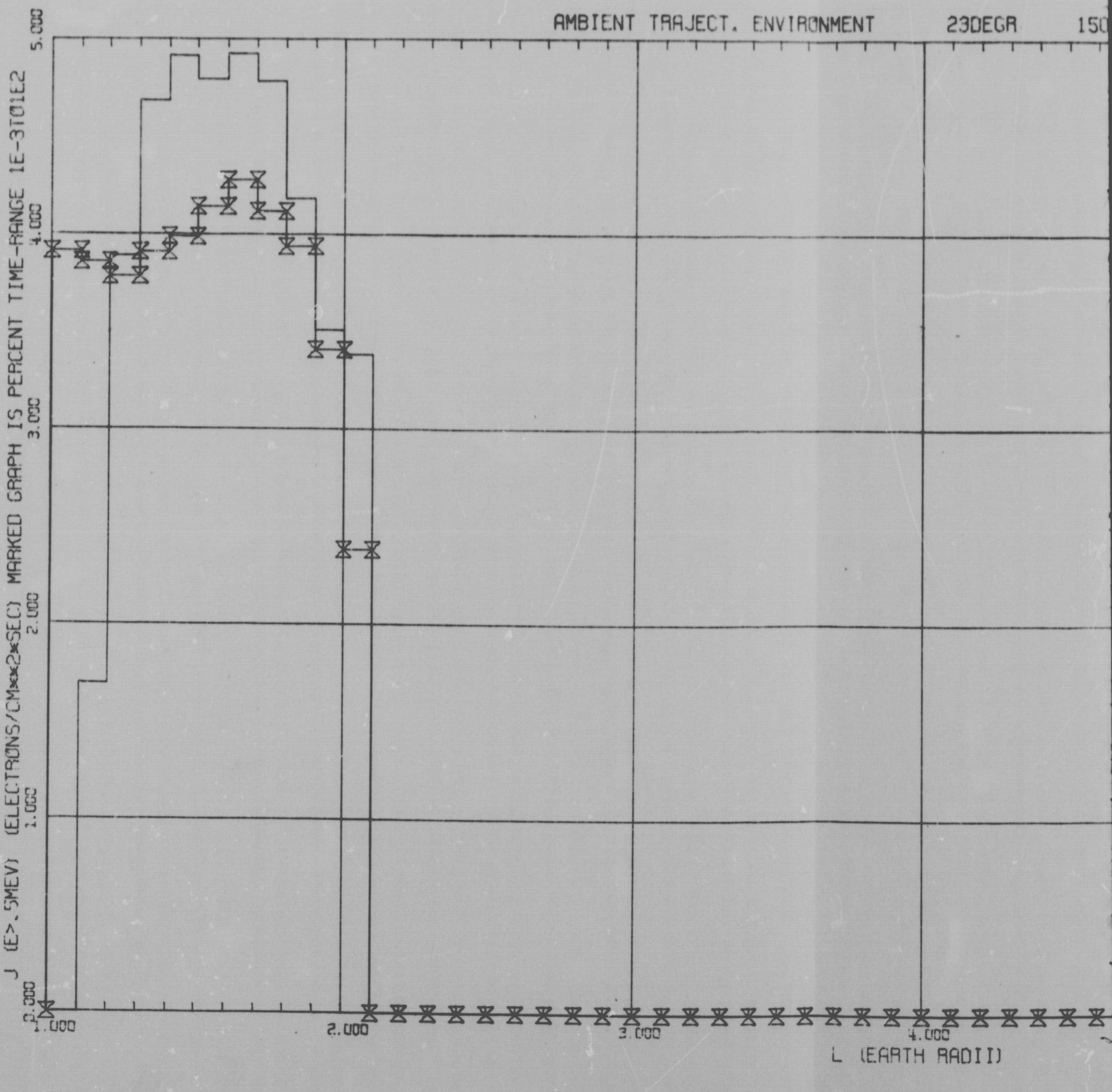
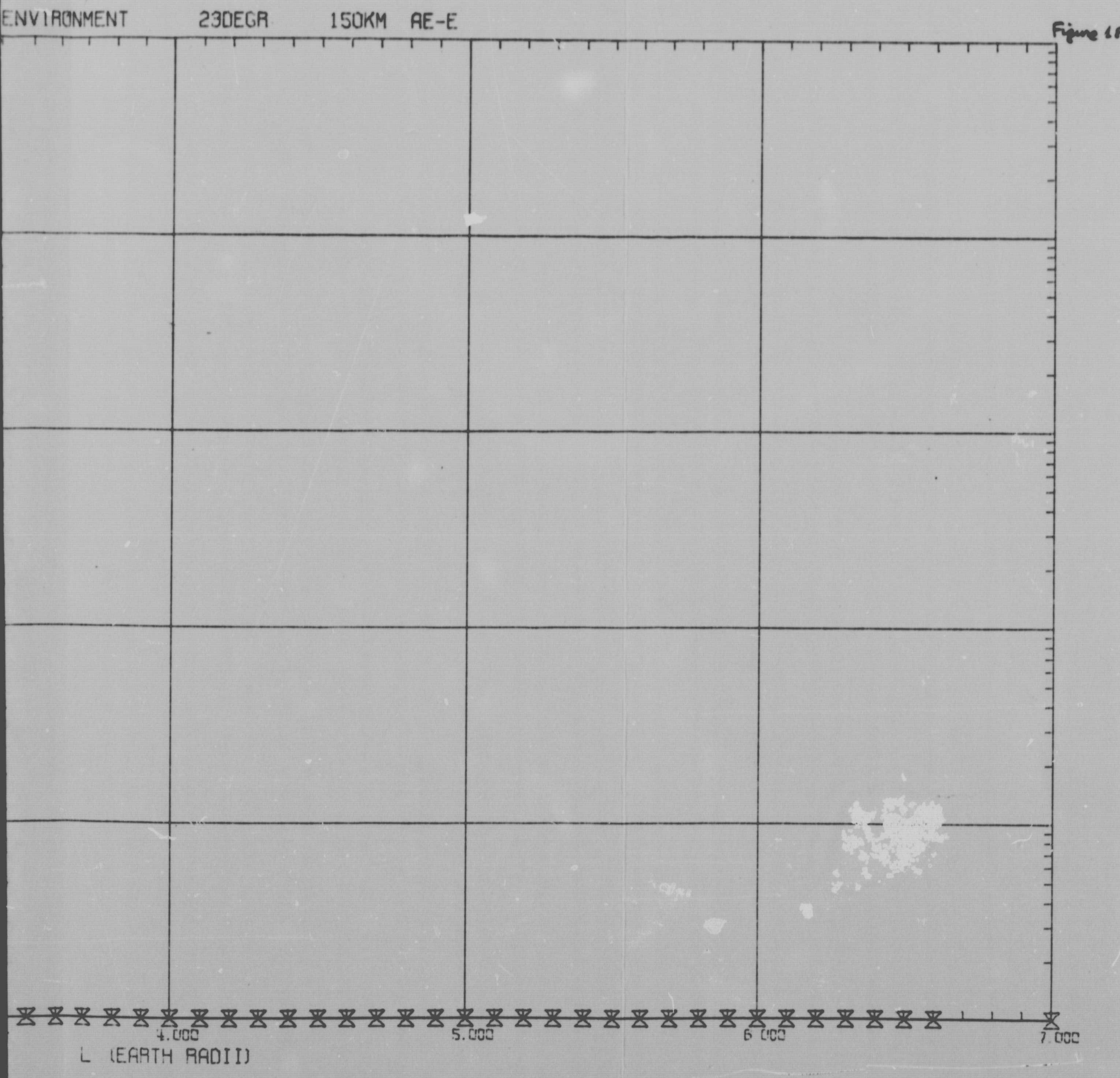

PEAK FLUX (PROTONS/CM**2*SEC) (E>5 Mev)
5.000
6.000
7.000
0.000
5.000
10.000
15.000
20.000
25.000
ORBIT NUMBER
PEAK FLUX ENCOUNTERED IN EACH PERIOD 80DEGR 150KM AE-D

Figure 17

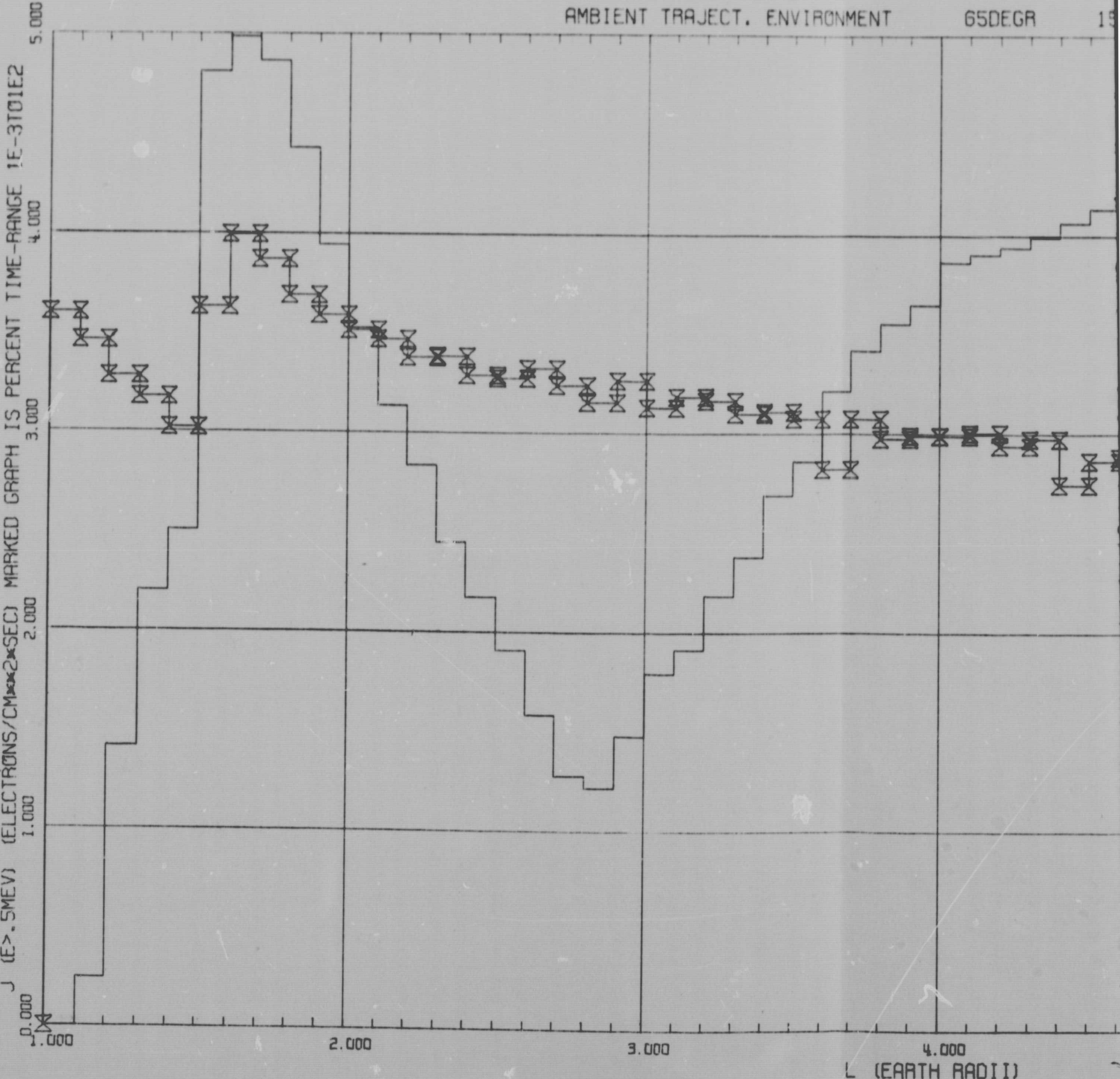
FOLDOUT FRAME 1



FOLDOUT FRAME 2



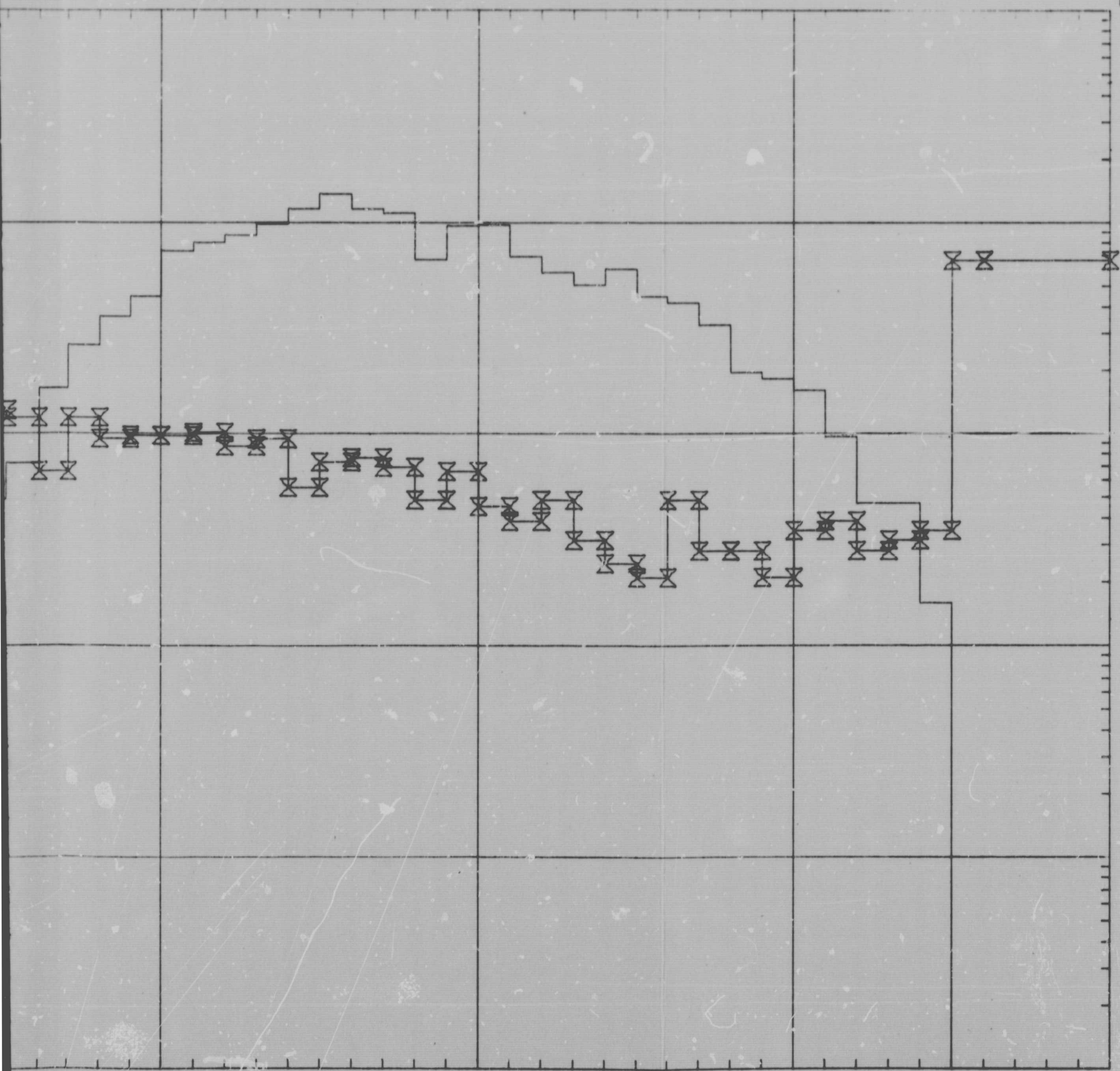
FOLDOUT FRAME 1



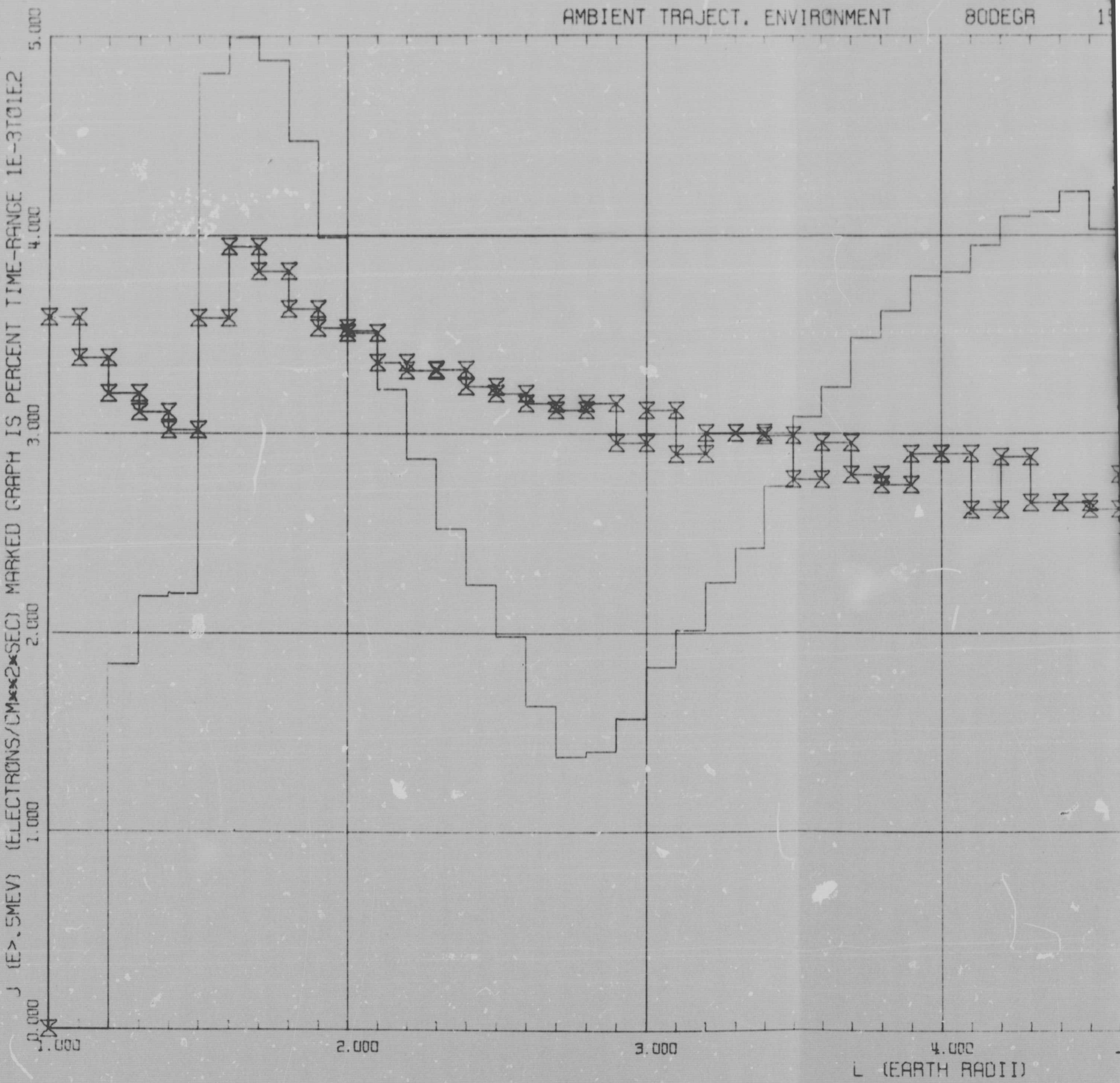
FOLDOUT FRAME 2

VIRONMENT 65DEGR 150KM AE-C

Figure 19

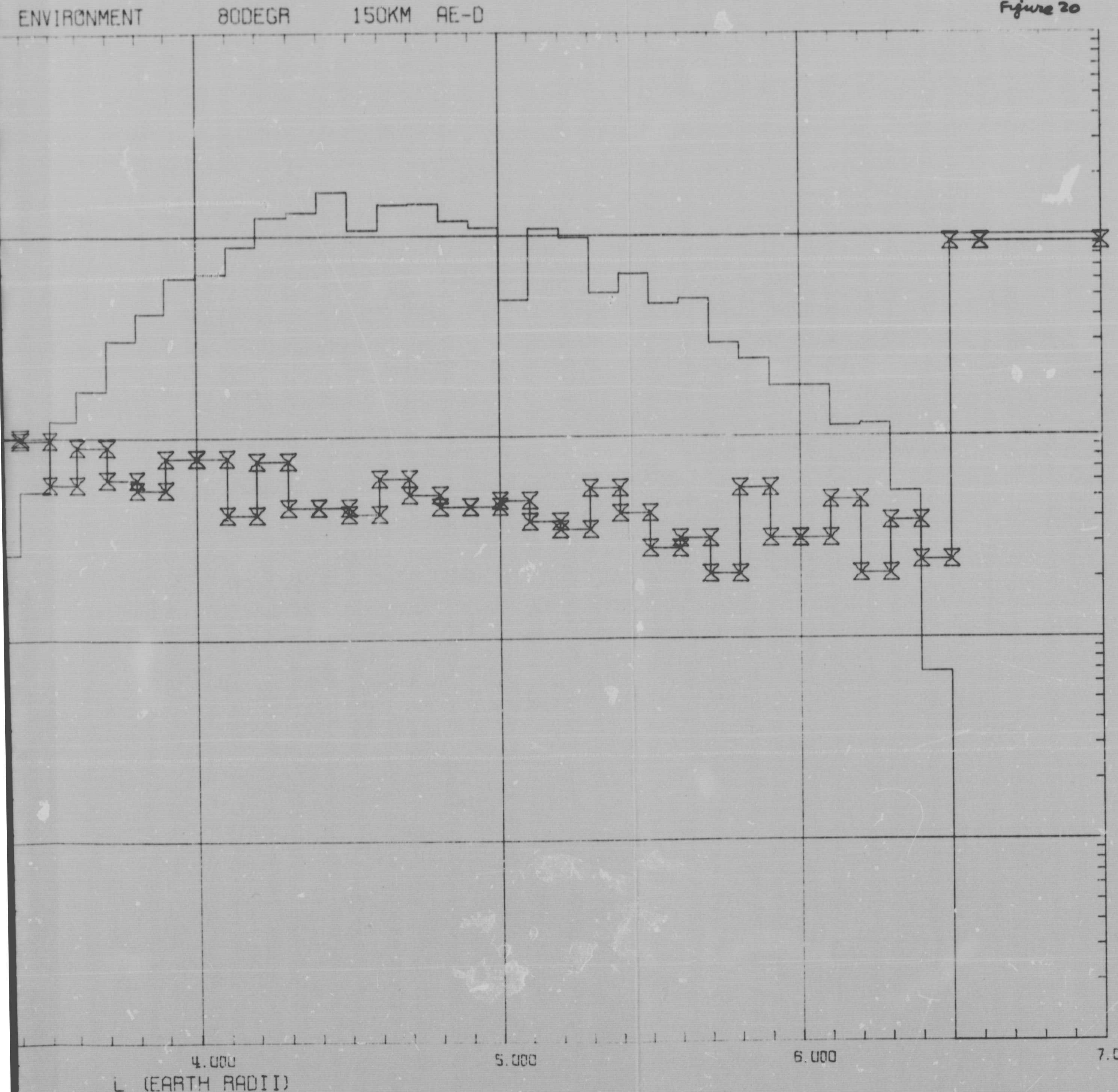


FOLDOUT FRAME 1

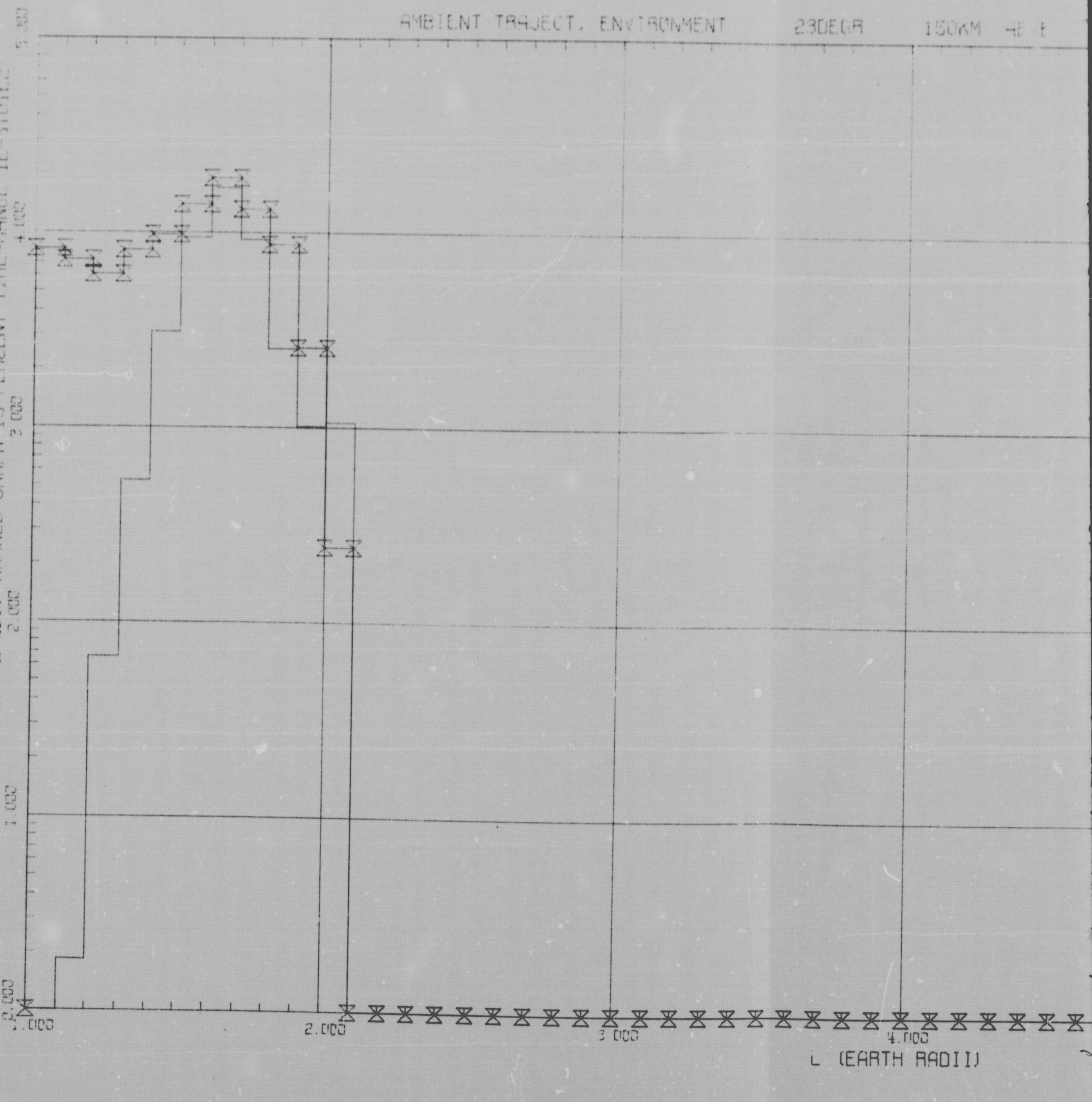


FOLDOUT FRAME 2

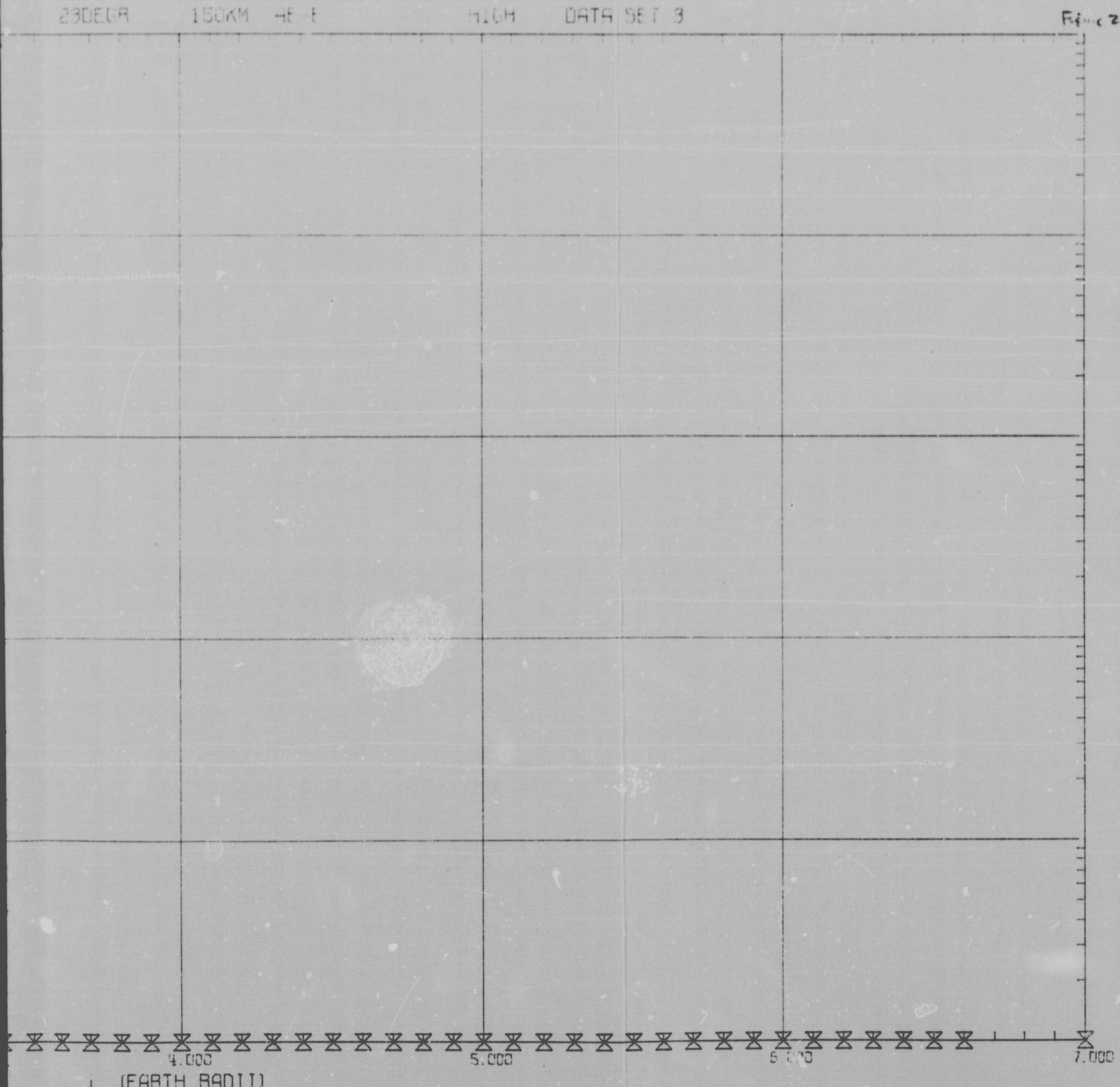
Figure 20



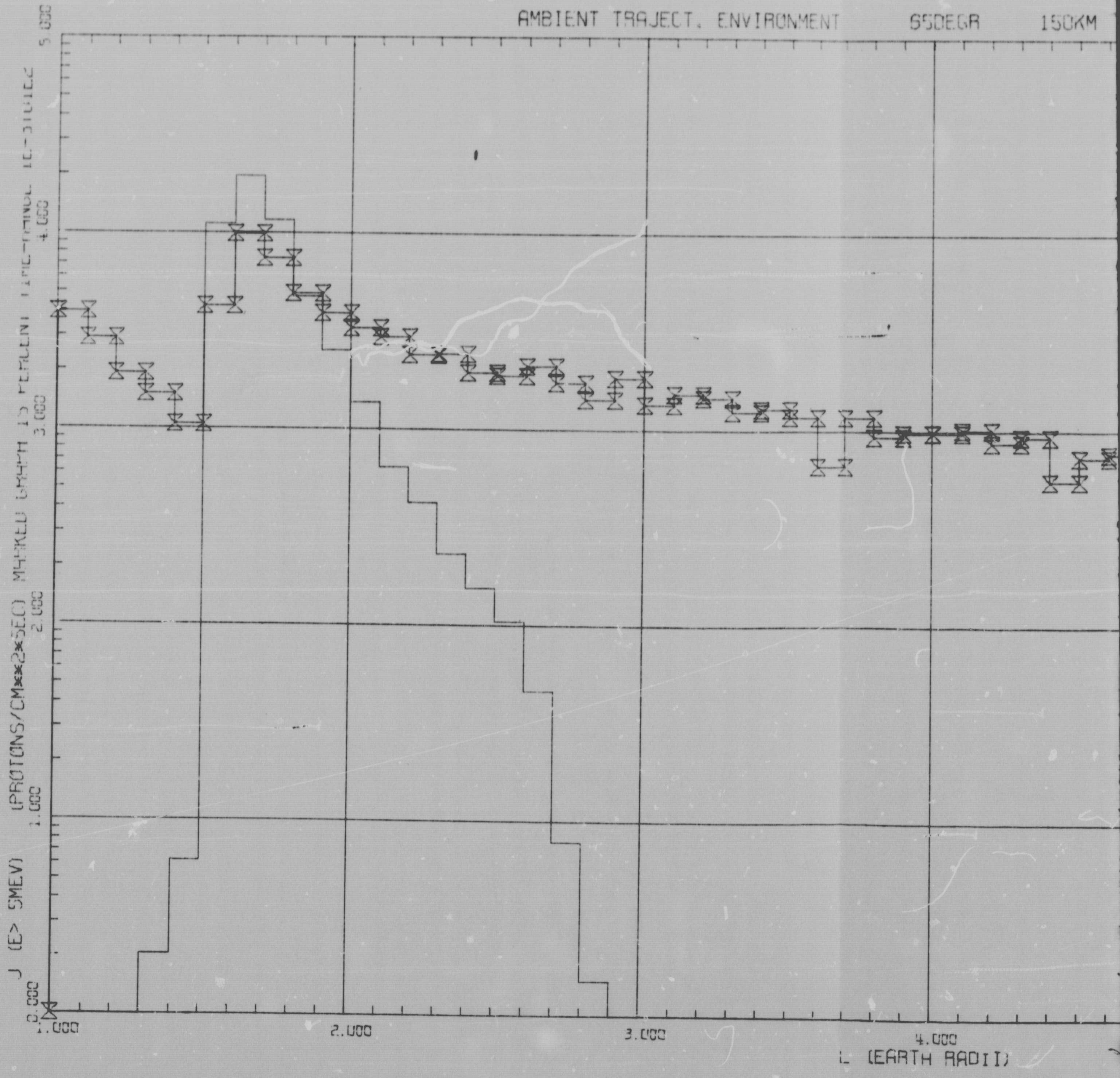
FOLDOUT FRAME 1



FOLDOUT FRAME 2



FOLDOUT FRAME 1



FOLDOUT FRAME 2

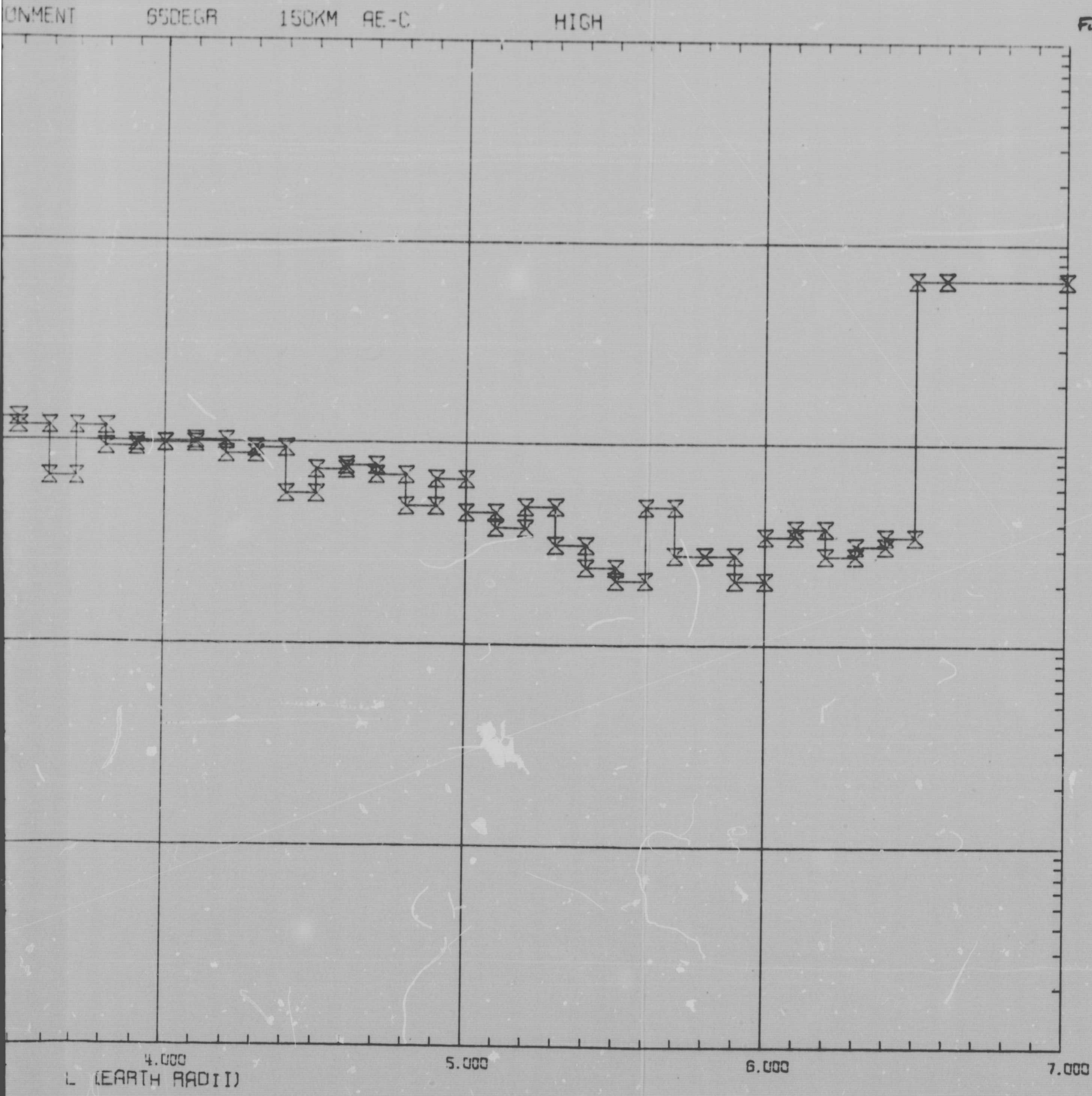
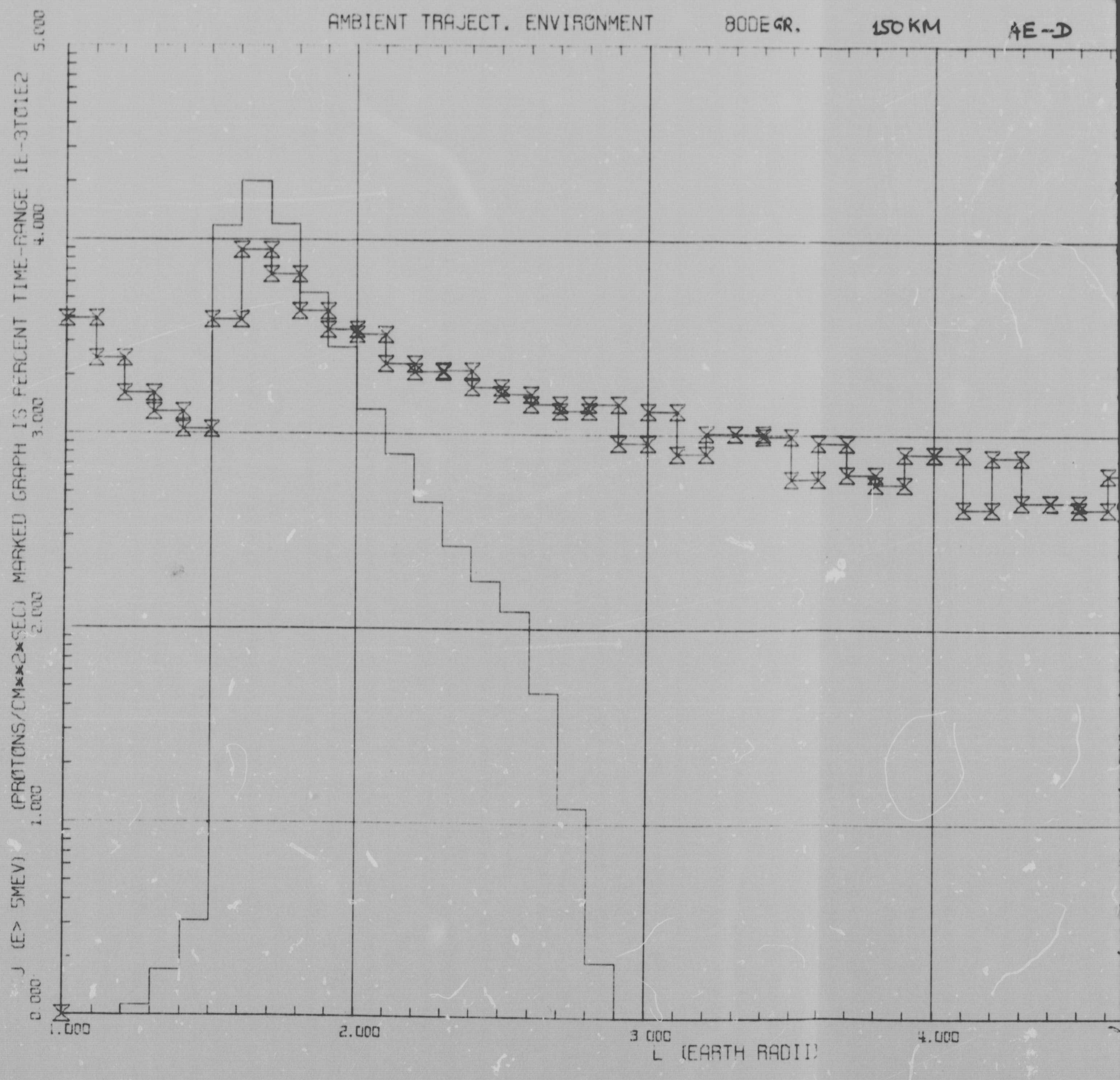



Figure 22

FOLDOUT FRAME 1



FOLDOUT FRAME 2